Valuing Open Space: Land Economics and Neighborhood Parks

by
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Abstract

The thesis of the work is that statistical analysis can reliably measure individual preferences for different aspects of the built environment. These measurements can be used to understand and critique the effectiveness of existing neighborhoods in meeting the needs of residents, and to develop proposals for new neighborhoods.

The research uses hedonic regression analysis to quantify the market value of specific attributes of housing quality, location and neighborhood at sites near Dallas, Texas. Measurements of location value in the form of travel-based rent gradients, proximity measures, and path characteristics are derived from these analyses.

The research allows designs to be produced and critiqued with a better understanding of both homeowner preferences and market feasibility. It links the design process to a market-based feedback mechanism, and allows designers to make decisions that are more responsive to a project's social and economic site.

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Introduction

This thesis addresses the value that people place on particular attributes of their environment, and the role that those valuations can play in explaining, critiquing, and designing the built environment.

The work principally addresses the way that design can increase the value of neighborhood parks to landowners and residents, and thereby increase the frequency with which they are provided in new developments. A principal goal, then, is a methodology for designing neighborhoods that utilizes market information to support careful design and the inclusion of recreational park spaces.

The value that residents place on living in well-designed neighborhoods or communities, measured by their willingness to sacrifice for that privilege, offers the best possible feedback for planners trying to improve their work and the built environment. In housing markets as in anything, prices are a way, imperfect but telling, of talking about values: community, open space, safety, comfort. Prices are often the only way of comparing those different values.

The thesis comprises several distinct sections:

The first section includes a review of prior writings about the role that parks play in building and preserving the community. Different hierarchies of park and street systems are briefly introduced and compared.

The second section reviews some models of how places become centers and how proximity can be valued. It presents and develops a basic model of proximity within different street grids.

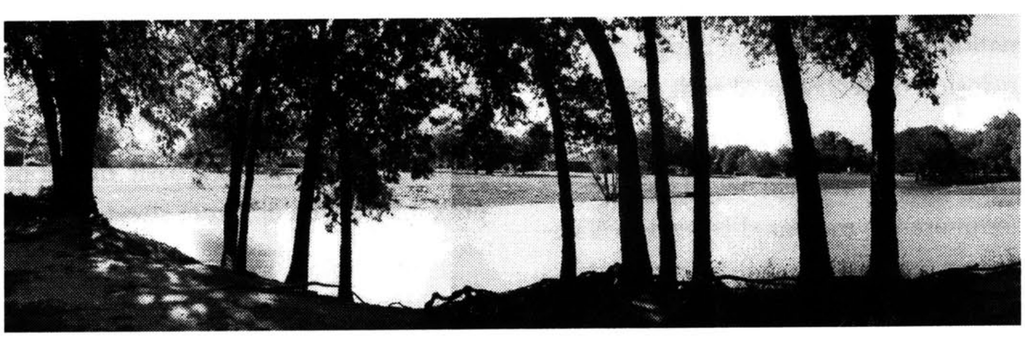
The third section presents the research hypotheses, a review of previous research on the topics, and the data sets and assumptions used to test those hypotheses. Basic measurements of proximity value are derived for parks as well as other location amenities.

The fourth section presents and analyzes a series of case study neighborhood plans. The emphasis is on how the street pattern affects travel distance from any given parcel to a series of parks. Based on the review of historical work, statistical and site research, and a series of case studies, a series of generalized rules are proposed as design aids.

A neighborhood park is defined here as a park serving primarily the community within easy walking distance. Children must safely be able to reach the park, and so no major roads or barriers should separate a park from the homes it serves. Indeed, any conditions that deter pedestrians, like strip developments, railroad tracks or institutions, define the edges of the area the park serves.

There is a clear connection between the idea that walking distance to a park is one critical measure of its value to an individual property, and traditional ideas about the nature and role of the neighborhood unit. In part for this reason, the work includes extensive references to neighborhoods, and to the role that other facilities might play in determining the value of residential location at the very local level.

The term 'neighborhood park' then defines an ideal, rather than a specific set of examples. It functions in a particular way, rather than meets particular characteristics. This means that it is specific attributes of the park and its surroundings, rather than the park itself, that are in the end being examined. It also means that no single hypothesis about the value of neighborhood parks can be tested and either accepted or rejected. Instead the parks, chosen for rough correspondence to an idea about the role parks play in a community, were analyzed in search of patterns in their economic performance.



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The goal of this thesis was to isolate - at least in part - some of the inferred values underlying conventional suburban development patterns. Those values form part of a coherent system, one that can support alternate forms of practice as easily as it supports current standards. Only through an understanding of that underlying system, however, will those more sustainable and profitable patterns of development become viable for commercial practitioners.

The specific subject of the research is the neighborhood park, its market value in privately developed neighborhoods and its economically optimal form. Market value, however, depends on the benefits that a park provides to its neighbors, users, or community. To understand market value in a useful way requires first consideration of what those benefits of the park are and how people might assess the value of those benefits. Also necessary is an understanding of how parks relate to their surrounding environment, and how that neighborhood's design will strengthen or dissipate the value of that park.

A large body of theory exists addressing the value of parks to communities and individuals. It includes extensive work addressing the effects that parks may have on municipalities, the environment, and communities. These different understandings of what parks should do as part of a community and a landscape have determined the form of contemporary parks, and the expectations that different parties - whether designers, developers, city officials, or activists - bring to discussions of parks. A framework for thinking about the benefits of parks creates the potential for creative, forward-thinking solutions. Addressing the needs that underlie parks, not just their formal properties, will produce parks that are not just amenities but vital parts of the neighborhood and its life.

The American Civic Association, or ACA, was founded at the turn of the twentieth century with these values in mind, and to promote, among other things, the inclusion of parks and recreation spaces in urban areas. Part of the City Beautiful movement, it grew from the merger of the American Park and Outdoor Art Association and the American League for Civic Improvement in 1904.[1] The organization saw parks first as aesthetic elements, vital in building the city. Second, parks were a means to civilize and control the working classes, engaging them in the processes of bourgeois civil society. Third, the ACA's interest in parks planning engaged it in the debate over property rights, and of the rights of the community to impose on the individual for public ends.

The list provides a way in which to think about and critique the effects of the parks it produced. Equally, a contemporary list of the effects of a park provides one way of discussing the shortcomings of contemporary parks with respect to contemporary values, and of proposing alternatives that might better respect those values.

[1] For a discussion of the ACA's philosophy and history, see Young (1996)

This section presents four basic areas of effect, encompassing financial, environmental, social and health issues. Each of these areas is developed to address a specific problem limiting park's broader incorporation into new neighborhoods: that the benefits of the park are difficult to calculate, while its costs are not.

This goal of quantifying the benefits of parks sets the focus for most of the subsequent analysis. The question is not simply whether parks are attractive or can be made so, but how precisely those attributes would manifest in consumer preferences, and how the preferences of individual consumers would be measured.

Personal utility functions for aspects of parks or open space, it is argued, are essentially comparable across individuals through the mechanism of market pricing, and can be summed to find what utilitarians might call the socially optimal outcome, but which can just as easily in this context be called the profit-maximizing outcome. This is an understanding of social good based on revealed preferences rather than social welfare judgments. In this way, issues relating to parks - even highly emotional ones - can be understood as manifesting in social and market mechanisms. Market processes allow informed conclusions about social welfare, far more than would subjective judgments by an individual as to the best outcome for society. A revealed preferences approach to neighborhood planning will emphasize the further articulation of social mechanisms that permit individuals to best realize their own goals.

Individuals will, in turn, pay more for housing goods and services that better reflect their utilities, and that premium will generate an incentive to produce those more desirable products. Exploitation of disparities between the optimal pattern of utilities and the existing one will ultimately reduce those disparities, as more competitors enter the market. In the meantime, however, parties can earn supra-normal returns on their investments by producing housing products that more closely reflect market preference, and by utilizing scarcity-driven pricing power.

Social welfare judgments do play a role in this process, by revealing the practical boundaries of revealed preferences. Just because more expensive homes receive a higher rate of return, for example, does not mean society should build only luxury housing. Social welfare judgments serve to remind that even revealed preferences must be sustainable.

The scarcity of parks in modern suburbs is due in part to this difficulty of measuring these benefits to residents, and the resulting willingness-to-pay of those residents. If the principal attributes of parks do have utility, however, those preferences must already be implicit in the market choices of consumers, regardless of whether those values can at this time be calculated and summed across a population. In effect, the market already does quite well what the research purports to prove through exhaustive analysis.

For existing houses and neighborhoods, organized economic models have limited value. They may reduce uncertainty associated with the pricing of proximity benefits around parks, and so raise the effective risk-adjusted return on invested capital. (Homeowners, after all, receive a return on their investment whether or not that's the principal reason for the purpose of buying the house.) Data on performance over time of properties near parks may indicate patterns of mortgage default risk, and permit banks to make loans accordingly. These economic efficiencies, however, are not by themselves highly relevant to developers or designers.

The data provides real value, however, in the design of new neighborhoods. Developers and home builders must know what the final equilibrium distribution of premiums with respect to distance will be before any parcels are sold. Otherwise, prices will likely be either too low - sacrificing margins - or too high - reducing sales velocity. Either outcome brings large costs, and thereby affect the relative attractiveness of developments utilizing amenities. Financing sources, too, require predictability just as much as they require that specific premiums be achieved. The risk represented by uncertain premiums affects the availability or cost of debt, and by extension the feasibility of new proposals.

Designers, too, make choices based on their understanding of consumer preferences. Much of that understanding is based on informal observation and research, and may have some basis in fact. Much of it does not, however, as evidenced by the many projects that fail to create or sustain long-term value for their developers, owners, or occupants. There is value for designers in verifying their generally accepted rules of thumb, not least because other stakeholders may not place similar value on those rules of thumb. Architects and planners, for example, have decried conventional suburban planning for decades to at best modest effect.

Individual consumer have the ability as a group to assess all available properties in a marketplace and to arrive at valuations that are - based on their measurable characteristics - generally consistent across properties. This, by itself, is not sufficient to produce optimal market outcomes. It is entirely possible for consumers to desire specific neighborhood amenities, and yet for the marketplace to continue to fail to provide them. The methods used by developers and financiers to evaluate innovations are different from the ones consumers use to evaluate the properties resulting from those innovations. While markets can accommodate this discrepancy in most cases, some items - parks, for example - have tended to fall through the cracks.

Key, then, is to translate consumer utility measures into the more abstract financial measures used by financial markets. The text then attempts to treat value-laden utilities in economic or financial ways.

Financial Impacts

In 1870 Frederick Law Olmsted wrote of Central Park that, " (it) is universally admitted that the cost...has been long since much more than compensated by the additional capital drawn to the city through the influence of the [Central] Park."[2] An 1892 report, for example, found a tax benefit to the city of $21,000,000, [approximately

$400,000,000 in 1999 dollars] net of that park's construction and maintenance cost. [3] The city of Cambridge, Massachusetts analyzed the fiscal impact of Cambridge Field shortly after its completion in 1896. It found that, "this territory, at the end of three years, after being reduced 26 percent in taxable area, on a tax rate of $15.10 on $1,000, showed an increased yearly earning for the city treasury of $2,358.62 [approximately $48,700 in 1999 dollars]."[4]

The above examples are early recognitions that neighborhood parks represented not just social but economic propositions. Planners of the time did not consider the economic benefit of the park to be its principal justification, citing instead the need for recreation, something "not the ordinary routine of one's existence."[5] However, if the benefits of the park - indeed, the measurable financial benefits alone - exceeded the park's cost, then financial benefits could be used to justify the park's construction. Frederick Law Olmsted, writing in 1868 to the future developers of Riverside, cited the "vast increase in value of eligible sites for dwellings near public parks" to justify his suburban plan. Economic value rather than recreational benefits justified the park, whatever the park's other benefits might have been.

The use of squares or gardens to boost property values in urban neighborhoods has numerous precedents both in the U.S. and in Europe. Even in 1850, townhouses in Boston's south end sold for a 59% premium if on a Federal style park relative to other nearby homes. [6] Many early residential squares were the product of speculative developers seeking to generate such premiums.

In densely built areas like London or Boston's south end, the benefits of a park are obvious; ventilation, open space, sunlight, greenery, access to recreation. Less immediately clear is what the scope of those benefits would be in a garden-style suburban neighborhood, for example, one whose planning is predicated on substantial open space and "the charm of refined sylvan beauty and graceful umbrageousness."[7] Instead of providing contrast to its surroundings, as in an urban park, the suburban park would provide continuity, and reinforce the image of the neighborhood. Low density restricts the viability of the suburban park in more than just aesthetic ways. For example, few homes in a suburban environment

[2] Olmsted (1870), p. 35.

[3] Report, New York Park Association, 1892, quoted in Nolen (1913).

[4] Report of Cambridge Park Department, 1896, excerpted in Nolen (1913).

[5] Hubbard (1914).

[6] See Moorhouse and Smith (1993)

[7] Olmsted, Vaux & Co. (1868)

will have the all-important park frontage relative to what the densely built urban square might offer. If the land premiums are to support the additional infrastructure cost, then, either the premium must be substantially higher in suburban markets relative to urban markets, or the cost of land must decrease disproportionately relative to the number of houses around the park.

Even if the cost of the land devoted to the park is lower in a suburban neighborhood, it is only one part of the park's total expense. In addition to opportunity costs, which vary as a function of density, park costs include considerable construction and maintenance costs, which are principally fixed with respect to the surrounding density. The adjacent homes - the ones that presumably benefit from the park the most - must support these costs regardless of density. For this reason alone, the suburban park is more costly to its neighbors than its urban equivalent.

Maintenance

Municipalities have traditionally treated parks as a general community expense, apportioning costs among residents in accordance with the ratios for other municipal services. Private developers, however, far more than cities, need precise estimates of the value of each individual parcel in a development. The distribution of maintenance costs with respect to the value of the park will affect the relative value of homes near to or distant from the park. Discrepancies, even if they average out across the development, raise time to sale for some lots and so impose financial costs. Treatment of park maintenance expenses as a common expense, while acceptable for cities, may not be sufficiently precise for developers seeking to price parcels accurately.

Private developments have historically used a number of strategies to distribute costs of common area maintenance. Subdivisions designed by the Olmsted Brothers, for example, varied widely in their treatment of such expenses. (See Table) That the journal *Landscape Architecture* would have published a special supplement on this topic suggests that debate was still very active at the time (1914) about how an organized system of common services could be provided without public agencies.

Each case in the supplement treated roads and infrastructure as the principal ongoing maintenance expenses. The distribution of expenses for primary infrastructure was complicated, but still had an intuitive foundation. Many proposals for distribution could be and were made

[8] Olmsted, Vaux & Co. (1868)

with a reasonable claim to procedural fairness. Other costs, however, particularly those relating to the most heralded aspects of the planned neighborhood or garden suburb - "informal village greens, commons and playgrounds" in Olmsted's words [8] - were far more complicated If parks were treated as necessary social infrastructure, as the ACA or other reformers might have proposed, then costs could be evenly divided among residents based on the same kind of arbitrary but internally consistent logic that governs property tax assessment. Doing so, however, would give a series of misincentives to property buyers and developers. The even distribution of costs - like that used by the Olmsted brothers - will subsidize homes near the park relative to those furthest away. This subsidy for proximity may conceivably encourage homeowners to locate near parks. More likely, however, is that the costs of properties within the neighborhood but at the edge of the park's range of influence will be too high relative to those of adjacent subdivisions built without amenities. While the best lots will sell quickly, other lots will be less likely to sell at all. In this way, the absence of reliable data on the benefits of parks creates economically inefficient outcomes.

Subdivision Name	*City*	*Year Built*	*Maintenance Costs*	*Responsibility*
Roland Park	Baltimore	1897	Not more than $0.25 per front foot per year	Company
Lake Shore Highlands	Oakland	1917	"Various as to Service"	Company
Bonnycastle Terrace	Louisville	1907	Equal regardless of frontage. Lien held to ensure payment	Company
Guilford	Baltimore	1908	Up to $.20 per 100 square feet of lot	Company
Barton Hills	Ann Arbor	1922	"proportionally"	Corporation of the owners
Great Neck Hills	Great Neck	1919	$2.00 per year per owner until 1926	Company until 1926, then abutters unless taken by city

Table
Excerpt of table from *Landscape Architecture* showing distribution of common maintenance expenses in early Olmsted suburbs.

Maintenance expenses can also affect the design and placement of parks within neighborhoods. Many cities, especially suburban cities like Carrollton, Texas, consolidate park acreage into a few very large parks to control these costs. They perceive rightly that the fixed costs of maintaining a park of any size are substantial relative to the marginal maintenance cost associated with additional acreage. The largest total amount of park acreage can be provided for a given level of expense if that park space is heavily concentrated.

The optimization of ongoing costs, like the distribution of those costs, misaligns incentives when done incautiously. The greatest social benefit accrues when a neighborhood formerly without green space acquires its first half-acre. The value of a fifth acre of park is small by comparison, but its cost to acquire and construct may be similar. In this respect, arguments about optimal park size that are based on maintenance efficiency are seeking to maximize the wrong variable. Park acreage is less important than the accessibility of that acreage to residents.

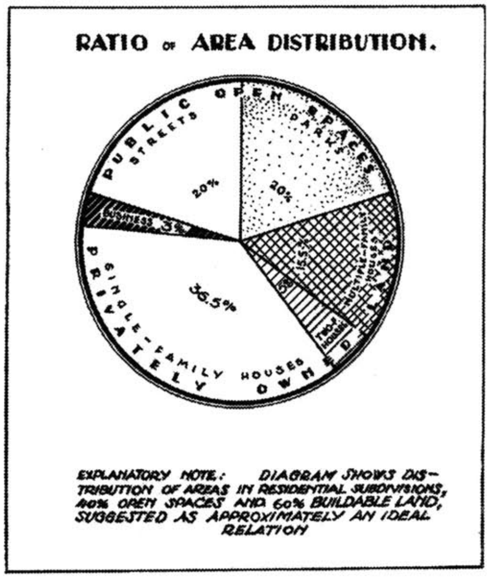
Thomas Adams, writing in 1934, proposed an optimal distribution of facilities in a neighborhood plan designed to balance costs and benefits. (Illus. 1.1) Single-family homes comprised the largest portion of land, at a precise 36.5%. Allowances were made for two- and multiple-family houses, and park space was proposed for 20% of the neighborhood's land. Like any standard based on hard numbers, this one encourages cities and developers to address the wrong issues.

Target figures for the provision of park space like square feet of park or playground per person [9] - whether advanced by municipal organizations or progressive reformers, encourage organizations to produce solutions optimized for those figures. Park acreage is, however, only a proxy - and a crude one at that - for the real value that parks provide. Municipal regulations that regulate minimum park size persist in part because only data on park costs exists and has been widely studied. Solutions are developed to minimize the measurable costs rather than unmeasurable benefits.

Development value

The value placed by residents on specific amenities or on neighborhood attributes must eventually benefit the profit margins of the developers who provide those amenities.

Developers of planned communities, particularly those incorporating amenities, incur substantially higher initial costs than those of conventional subdivisions. Design and planning fees rise as the plan becomes more sophisticated,



Illus. 1.1
Ideal proportions of different uses in neighborhood, per Thomas Adams

as do the costs of coordination with consultants. Deviations from conventional practice typically require municipal code variances if they are permitted at all. The permitting process absorbs additional time and labor, both of which are costly. The uncertainty surrounding innovative product types may affect the availability or cost of the capital needed to pursue the project. Lastly, the risk embodied by plan innovations makes the project less attractive for any given level of profitability to the developer as well.

The economic viability of the neighborhood requires not just that the initial sale premium generated by the park cover its design, construction and maintenance costs, but that the premium be reliably known prior to construction. Otherwise, the park substantially increases the total risk of the project. Lenders require a higher rate of return in compensation for that unknown level of risk, and this raises the cost of debt and reduces the project's feasibility relative to conventional developments.

At every level, the well-designed community faces additional costs, due either to the cost of construction or the uncertainty as to the benefits, that must be reliably offset by premiums. One goal of a developer who builds neighborhoods with parks and other amenities is to produce a specialized, differentiated product rather than the commodity product of conventional practice. This reduces the effective field of competition. Really good development requires a set of skills and expertise not widely available. Because the necessary skill set is difficult and costly to acquire, barriers to market entry are high as well. Less crowded, competitive market niches are more likely to permit high, sustained returns.

The market for conventional suburban housing, in contrast to that for

[9] The North Central Texas Council of Governments, for examples, recommends that municipalities have at least 18.6 acres of parkland per 1,000 residents.

products differentiated with amenities, is characterized by low barriers to entry and high levels of internal competition, and functions somewhat like a commodity market. The problem with this, however, is that commodity markets - in which the standards of quality are easily known and understood - are characterized by lowest cost production methods. Direct competition with lowest-cost developers, then, places developers of more sophisticated, innovative products at a disadvantage.

To avoid this, the product must be differentiated from lowest-cost substitutes. The differentiation must reflect actual market preferences that cannot be supplied easily by low cost methods. Neighborhood park systems, if based on research and experience, meet this requirement. Second, the differentiation must be easily communicable to the market, and identifiable within the noise of the marketplace. Conventional developments rely on a host of superficial architectural details to differentiate their product within the market. The so-called "North Dallas Special," for example, a pile of plastic moldings, gables, arched windows and monumental staircases, is designed precisely to overwhelm the senses and any rational assessment of the property's benefits. Community, too, has become a sales tool used to spruce up otherwise undistinguished subdivisions. A prospective homebuyer, reared in the suburbs and lacking exposure to urbanism, may have no way of distinguishing a neighborhood with the potential for community from its pale imitation. The benefits of responsible planning and design must be not just real - and verifiable through research - but saleable.

So, a further task of the developer is to educate the consumer. Here, the celebrated models of parks and neighborhoods - be they Olmsted's emerald necklace in Boston or Seaside, Florida (granted, not a neighborhood, but invoking many concepts of a neighborhood in a highly memorable way) - have value, because they provide a means for people to visualize and talk about what distinguishes a well-planned neighborhood from an unplanned or desultorily planned one. Marketing presentations, and the role of advocacy groups working in the public sphere, play a crucial role too in creating the knowledge that sustains demand.

Another opportunity, besides selling the value of amenities to the users, is to sell the effect of the amenities on the financial performance of properties. High levels of residential mobility encourage homeowners to think of their property as an economic asset that trades in a marketplace. Many conventional developments meet this need by providing housing stock that resembles a commodity; homogenous and easily replaced. The research, however, implies that the impact of physical deterioration of the housing stock on the value of the asset is substantial. Methods of valuation that emphasize the commodity nature of housing will produce neighborhoods with poor financial performance. Instead, it is the unique aspects of the housing stock - location with respect to unique and desirable amenities or services - and the non-depreciating aspects - landscaping - that provide the best defense of a property's total value. The old saw "location, location, location" applies at both the metropolitan and the very local level.

Homeowners reliant on property as their principal investment are a natural audience for data on housing valuation, if that data is presented in a way that helps them make the critical decisions. Data that allows homebuyers to make informed distinctions between otherwise apparently similar properties has enormous practical value. A demonstration that park proximity premiums are a resilient characteristic of the market and not just a preference of the individual homeowner transforms what was a costly consumption choice - amounting to as much as one quarter of the sale price of the home - into an investment.

Further, the financial performance of the proximity premium will differ over time from that of the physical attributes of the house. New houses typically depreciate in value at a declining rate over at least the first fifteen years. Indeed, Waddell, Berry and Hoch (1993) found that 20% of the value of the built improvement vanished in the first fifteen years. If the sale price of the house rises, that is likely the result of growth in the city and the rising value of the property's location relative to a lot at the expanding perimeter. Residents at the city's edge, facing longer travel times to the CBD, will pay premiums for older homes with shorter commutes. The age-adjusted value of the home's physical attributes however - its bathroom fixtures, furnace, roof shingles, and styling - are declining. In early years, the inferred rate of decline can be as high as 1% per year. (Waddell, Berry and Hoch)

A large percent of the value of new homes that are built at the urban perimeter on inexpensive land is based on these depreciable physical attributes. In contrast, homes in desirable locations will be more price-stable with respect to depreciation of physical assets, because depreciable assets comprise a smaller portion of the home value. The effect of better diversifying the components that contribute to home value - metropolitan location, immediate location, physical attributes, municipality, and so on - will be to reduce stabilize the home's market value over time.

Like land, landscape appreciates in value over time, although for different reasons. The slow maturation of trees and shrubs contrasts with the rapid initial deterioration of new construction. When landscape amenities comprise a significant portion of the home's value, the two effects - depreciation of the building attributes and appreciation of the landscape attributes - will tend to counteract one another. Selling those benefits is complicated because the benefits of parks, like those of community, mature over time. The sale of the homes that determines a project's success must occur at precisely that point when the amenities are least developed - the grass newly planted, the trees small and spindly, the plantings immature. Instead, the ephemeral charms of the house itself are what look best at the time of sale. Unfortunately, those are the same attributes used to sell conventionally planned and built subdivisions, and so fail to differentiate the better neighborhood plan or the plan that provides more accessible open space.

Some developers (like Robert Davis at Seaside, Florida) have profited from the appreciation in value of well-planned communities and landscape amenities by holding lots for later sale. This requires very low land costs to be practicable, and suggest in turn a semi-rural location less likely to support a fully functioning neighborhood. Alternately, developers can retain ownership of properties within the neighborhood - rental apartments or commercial spaces, for example - whose long-term performance correlates with the economic, social and environmental health of the neighborhood. That commitment, in turn, can represent a signalling criterion used in the sales and marketing process to demonstrate the developer's interest and confidence in the future success of the neighborhood. Maintaining that neighborhood presence also requires patient capital, and a set of management skills very different from those used in the developer's general practice.

Environmental Effects

The environmental benefits of parks are by their nature small and incremental in effect. Planning that treats each element of the ecology at the scale of its related watershed - taking that term in its most metaphorical sense - would be the best way of designing a park. However, design at that scale requires either government oversight or the voluntary cooperation of numerous small landowners with opposed interests. Absent that, privately built parks - or most public

parks, for that matter - will always seem incomplete or simplistic when looked at from an environmental perspective. Until regional government or federal regulations evolve to address these issues, however, ecological design strategies that can be implemented within individual neighborhoods will remain the most sound practices available.

The principal types identified here are those serving general, neighborhood-based ecological functions and those buffering unique aspects of the site. The former uses includes drainage, wildlife habitat and air filtration, while the latter include wetlands, geological features, existing trees or woodlands, and steep slopes.

General Functions

Most environmental functions, including stormwater retention, wildlife habitat, and biofiltration, are simply incompatible with recreational uses. Biomass, for example, affects the park's ability to control air pollution and diffuse heat, but limits the active use of a park and may compromise the perception of safety. Conventional maintenance techniques for sports fields - with abundant watering, pesticides, and petroleum-based fertilizers - also impose heavy ecological burdens. The extremes of biodiversity, whether in the introduction of exotic species or the creation of a plant monoculture like the modern industrial lawn, degrade nearby environmental quality.

A few attributes, however, can be used to produce environmental ecological goods with economic benefits that are perceptible at the level of the individual neighborhood. Open water, for example, whether in streams, ponds, or lakes, is one of the features of the landscape with the most immediate ecological benefits. Even without surrounding landscaping, a system of waterways provides stormwater channeling and retention. This can provide substantial cost savings over an underground system. Streams can also be enormous visual amenities to a neighborhood, adding to the value of surrounding properties. This value depends on design; the accompa-

nying pictures show two opposed ways of creating open drainage streams.

To achieve the next level of benefits that parks provide is, however, much more difficult. Tunnard notes that for streams, "the correct solution involves reserving a buffer strip of proper width (some 50 to 100 feet or more on each side of the stream), in which natural conditions and natural growth are preserved so that the stream can be left to operate in its own way."[10] Buffers around streams or ponds attract wildlife and aid in biofiltration. Because streams and ponds form corridors or even networks, they amount to a system of wildlife corridors running through the neighborhood. Buffered streams will add value to a community, but not of a kind that produces easy benefits. At the same time, the opportunity costs of a 200-foot wide buffered stream corridor on a limited development parcel are prohibitive.

A further disadvantage of corridors designed for wildlife is that they conflict with both active recreational use and the perception of park safety. The low, dense undergrowth preferred as habitat by many animal species conflicts with active use of the park by residents, and reduces sight lines that ensure a feeling of safety. It is in part for this last reason that many public parks resemble savannahs, dotted only by small clusters of high-branched trees.When the site or regulation requires buffered streams, however, the analysis changes. Parks that can successfully incorporate necessary buffer zones, wetlands, drainage fields, or topographical features may be developable at little added cost. By highlighting these or other natural site features, too, parks can magnify those features' visibility and value to the surrounding neighborhood.

When sites have unique characteristics, conservation-based site design, incorporating parks, makes sense. Environmentally sensitive areas are delineated,[11] and streets and lots are laid out accordingly. Part of the financial appeal of parks buffering environmentally sensitive areas is that, unlike principally recreational parks, they do not compete with development for land. "The playground belongs in the midst of a densely populated area, and land in a densely populated area is expensive."[12]

[10] Tunnard and Pushkarev, p. 140.

[11] Arendt (1996) uses 'primary conservation areas' to denote areas that must be preserved. 'Secondary conservation areas' include buffer zones around wetlands or other sensitive areas, or wildlife habitat areas.

[12] Hubbard (1922), p. 27

[13] American,Sadie. "The Movement for Small Playgrounds." American Journal of Sociology 2, 1898, p. 167.

[14] Weicher and Zerbst (1973)

[15] Cited in Rowe.

Large, consolidated parks can accommodate unique local site conditions that a series of smaller parks could not. However, most large ecological features that would require protection are ill-suited to intensive recreational use. Ecological buffer zones, while important, can be only a small part of what are principally recreational park systems.

Health and Recreation

"Give the children adequate playgrounds, and the same spirit and imagination which form rowdy gangs form baseball clubs and companies for plays and games and drills of various kinds. Children's imagination is vivid, and must be satisfied...Feed it properly, and it will blossom into beautiful fruitage; starve it and throw it back upon itself, and we have all the ugly excrescences, deformities, and depravities of crowded -city life."[13]

In the eyes of progressive reformers, recreational facilities resembled less an amenity than infrastructure, providing concrete and necessary benefits to the community. Recreation, in this view, was essential to physical and moral health. Parks, particularly neighborhood parks, no longer serve this function to the same degree. Homes and lots are larger than in the past, family sizes are smaller, and residents have access to facilities outside walking distance. Despite this, parks still offer recreation and health benefits to users, and the nature of those benefits have economic consequences.

Recreation

While recreation is an essential justification for parks, many facilities for organized sports conflict with other goals of the neighborhood park. Large fields attract noise and crowds, whose effects are rapidly felt on the desirability of a neighborhood. One 1972 study, for example, found that a largely recreational park lowered the value of adjacent homes, while other nearby parks, whose virtues were primarily scenic, saw 23% price premiums. [14] Playgrounds, as well, can be noisy and disruptive. The initial phases of Stein and Wright's Sunnyside Gardens featured small playgrounds within each of the perimeter blocks. After noise complaints, subsequent phases of the development relocated playgrounds to a 3.5 acre park at the northern end of the site. [15] Large neighborhoods are better able to accommodate large, specialized recreation facilities. In part this is because they can better capture the rent gradient that pays for the cost of the park, but also because, by containing that gradient, they are less likely to attract strangers from outside the neighborhood.

As well as neighborhood parks, schools play a major role in providing children with recreational opportunities. There is "no clean-cut line to be drawn, at least in the case of children, between recreation and education, and facilities for the one often serve the other also."[16] For this and other reasons, parks and schools are often contiguous. Both the neighborhood park and the school serve residential areas, and become more efficient the more thoroughly residential their surroundings. Since both schools and parks require playgrounds, parking spaces, and public facilities, there are obvious economies in consolidating them with neighborhood park functions.[17] The effect of these factors is to reduce the importance of neighborhood parks in areas well served by schools. Because the trend is toward large, infrequently located schools, however, the freestanding park and playground remains vital to providing children with recreational opportunities.

Golf courses offer one exception to the expected disamenity effect of large recreational areas. Homes abutting the green traditionally command a 25% premium over homes less fortunately located. While that premium represents proximity value, it is based on factors other than actual use. The Philadelphia Inquirer has reported that up to 80% of buyers in new golf course developments don't actually play the sport.[18] The abutment premium, then, is for the benefit of open space and the status of the location. The difference between the premium accruing to golf course abutting lots and the apparent absence of a premium for lots abutting conventional parks may reflect the difference in control of the space. Golf courses, while busy, are used by a narrow range of people, during particular times, in a highly structured way. Users of a neighborhood park are less easily controlled or categorized, and so may represent additional risk in the minds of abutters.

Physical Safety

Oscar Newman's 1972 book *Defensible Space* discussed the impact of site planning decisions on the safety of communities, particularly dense urban areas. For Newman, as for most authors before and since, perception was treated as fact in the case of neighborhood safety. Residents don't go places where they feel unsafe, and thereby cede control of those places to those they fear.

[16] Hubbard (1922), p. 17.

[17] Carrollton, Texas, for example, groups schools and parks in the same policy statement: "Schools and parks should be encouraged to be centrally located and easily accessible to any section of the neighborhood, as much as possible." Policy RD1.27.

[18] Belden, Tom. "A Front Yard on the Front Nine." The Philadelphia Inquirer, Sunday, September 26, 1993. Reprinted in Arendt, 1996.

Effective oversight depends on neighborhood design. In low-density suburban neighborhoods, few people may be on the street at any given time. The design of the neighborhood and the houses within it, then, has to offer the *opportunity* for surveillance as a deterrent. Security patrol is by its nature episodic and expensive; if a park encourages a sense of ownership in abutters, however, those residents will be more likely to police the area informally themselves. Parks need clear lines of sight, both within their confines and to the outside community. In conventional subdivisions, however, even homes that face across the street may offer not surveillance but an 18-foot garage door.

Defensible space, based on community empowerment, operates through a process of exclusion and control. Public parks are linked to different kinds of private space - yards, kitchen windows, front stoops. In the process, they assume the character of semi-public or even private spaces, because nearby residents come to regard them as an extension of their own, adjacent property. The value of public parks then depends on both the design of the park itself and of the surrounding neighborhood with respect to visibility and control of space. Abutting homes that reject the park by building high fences deny the park not only to themselves but to the community as a whole.

Equally, the design of the neighborhood surrounding a park can affect the feeling of safety and privacy that adjacent homeowners have from the park itself. The most secluded areas of private parcels, typically the back half of the house and yard in conventional homes, abut highly public spaces. In the Dallas area, park-abutting properties frequently erect high fences, finding the lack of view less objectionable than the lack of privacy. (Illus. 1.2)

While concerns about security and public access may in some cases be a disincentive to locate near parks, the safety of the park for children benefits from proximity. As parents become more concerned about the safety of children in public places, the value of nearby parks should rise. Most preferred will be the back yard, but next - particularly for children playing with friends - will be

Illus. 1.2
View from a research park at adjacent properties.

the small park nearby, used chiefly by children in the immediate area and permitting easy, informal oversight by the community. In turn, the large 'neighborhood' park - located ten minutes away and attracting visitors from ten minutes away in the other direction - becomes a destination that requires the parent's presence. The value of proximity declines if the parent must always accompany the child, taking with it the premiums that would sustain the park.

Society and Community

Parks, which are one of the few amenities held and used by all a neighborhood's residents, can play a significant role in nurturing the common life of that neighborhood. That sense of community, in turn, affects both the lives of residents and the long-term value of homes within the neighborhood.

There are two basic models about how peoples or communities reach consensus and take action to preserve their values. The first of these, the economic model, postulates a *homo economicus* making decisions based on rational self-interest. The second, the sociological model, assumes the choices people make are dependent on a web of personal connections and reciprocal obligations. The problem with this dichotomy is not just that social interactions have value that can be calculated in part using economic terms, but that social interactions actually transform the personal preferences and goals that form the basis of economic calculations. Individual members of a community may value public parks or other amenities that are available to them as an effect of membership in that community. At the same time, however, the presence of a park itself alters the value placed by the individual on the sense of community that is partly a product of the park.

Communities provide not just symbolic benefits to their members, but a host of other opportunities and supports. Communities can serve as social networks, either aiding in upward mobility or cushioning the impact of personal misfortune. They permit assets and resources to be pooled, either for the purpose of acquiring special goods or services or to protect the community against threats to its overall wel-being. Neighborhood institutions, if carefully planned, can help to strengthen the network of ties that comprise a community and the sense of shared destiny that enables collective action. [19]

Mutual benefit, a traditional justification for community, might at first seem out of place in the modern suburb. For example, suburbs seldom exist for mutual preservation in the 21st century, though their walls and gates might appear to belie that fact. Similarly, revolving credit associations, or any of the other formalized strategies for community empowerment or personal security that exist, just do not play a significant role in the middle class landscape. Instead, the true benefits of community may lie in the information, contacts and support that the informal network of community can provide. The strength of this network is often called social capital, acknowledging the way it converts directly to the personal well being of those who have it. Social capital is like a public good, in that for any individual, most benefits of its creation accrue to others. Because of this attribute, most social capital is "created or destroyed as by-products of other activities."[21] Compared with its financial cousin, social capital "is less tangible yet, for it exists in the relations among persons."[22]

The web of reciprocal obligations that comprises a community depends on several things. There must be some stability of membership, frequent enough interactions that members can form trust, the probability of future interactions to encourage good behavior, and some means of enforcement of those general obligations. Neighborhoods are often connected with community because their physical structure supports these requirements. Residents stay for some time and can interact easily and often. In a functioning neighborhood, many redundant lines of communication exist. As a result, residents are responsible to the entire community for their actions.

Of course, the experience of conventional suburbs suggests that the physical proximity of residents is not enough to create community. Absent a pressing need, and absent institutions to encourage interaction, residents can easily remain isolated from one another. People now form close friendships all over a city or region, and would reject the notion that their principal relationships must all be formed within walking distance. What a neighborhood can provide easily, however, is a network of casual friends and acquaintances who are seen on a daily basis. It is casual acquaintances of this kind who turn out to be important in generating social capital. Each person in a loose knit group has many friends con-

[19] Potential residents in a neighborhood may not consciously make decisions based on these factors, but the frequency of commercial appeals to "community" and "neighborhood" suggests that the general meaning of the terms is valued. The purpose of this section, then, is to consider the economic benefits that might underlie a preference for neighborhood, and to consider possible implications of those benefits for neighborhood planning and the distribution of parks.

[20] Lynch, Kevin. The Image of The City. Cambridge: MIT Press, 1960.

tacts outside the group, who can serve as potential sources of information. Close knit groups of friends, in contrast, are likely to form closed loops, in which each member counts the other members as their primary friends. This limits the flow of useful information, whether trivial things like neighborhood news and gossip, or potentially more valuable things like professional contacts or employment opportunities (Granovetter). Perhaps for this reason, some research has shown that residents who know their neighbors report greater satisfaction with the neighborhood than those who know a few or none.[23]

Indeed, it is the organized opportunities for building just these kinds of loose relationship whose decline Robert Putnam lamented in his now famous article *Bowling Alone.*[24] Parks, as a physical institution for promoting social cohesion, represent a uniquely durable mechanism for promoting these ties. Residents can see each other and interact over time, building the familiarity that is the beginning of a social relationship.

Not all the effects of community are positive, however. The institutions of community seen in suburban neighborhoods in some cases can retard the growth of the neighborhood and the upward mobility of its residents.

Homeowners' associations, for example, may protect the conservative interests of the few instead of the best interests of the whole. The history of racial exclusion in the U.S. carried out through such associations is an especially bad case, but there are many milder but insidious examples. Restrictions on accessory units or sublets, for example, limit the financial flexibility of homeowners in response to lifestyle changes or personal crises. At the same time, such restrictions keep intact economically homogenous, low-density neighborhoods that are bad for the environment and for civil society. Covenants, too, restrict a wide array of housing attributes, from paint colors to lawn maintenance. These rigid community norms, enforced by social or legal pressure, can suppress a lot of harmless individuality to control a few troublemakers. Rigid property covenants may even retard the long-term prosperity of residents if those covenants are so restrictive as to prevent necessary growth and change.

The conventional suburban landscape, because of its very low density and its scarcity of major public buildings, lacks many of the necessarily compelling landmarks proposed as a wayfinding or

[21] Coleman, (1988) p. S118.

[22] Ibid. p. S100-101.

[23] Lansing, Marans and Zehner (1970)

imaging tool by Kevin Lynch.[20] Equally, the often highly consistent fabric of the suburban landscape lacks nodes, the critical 'places' that define a mental image of a neighborhood and encourage residents to think of it as a single entity. The use of parks to emphasize unique features can then play a significant role in the formation of a neighborhood's identity. This is as much an ecological as a social benefit, as it is most applicable to parks with distinguishing ecological features. Wholly synthetic landmarks are more difficult to create.

Symbolic Community

The figural open spaces of a community - the town square, courtyard, civic plaza - invoke the idea of common goals and of common identity that sustain the community. They do this in part, by demonstrating through their regular use that the community does indeed share common goals. The effectiveness of the park as a symbol of community has always depended on this correspondence between the space for common use and the common needs of a community's residents. Many of the functional needs that once sustained public spaces are gone or diminished. The New England town commons, for example, was once a messy multipurpose space, surrounding the town meeting hall and used by the town's residents. Now it is chiefly an ornamental space. Not just pragmatic but recreational needs are less dependent on common facilities. Play equipment is more common than ever in back yards, and many activities - hiking or bicycling, for example - are easier in larger parks outside the neighborhood.

As its functions are superseded, the park's importance as a symbol of identity grows. The most extreme example of the symbolic park in modern suburbs is the landscaped wall at the entrance to each new subdivision. Often the most lushly planted and carefully maintained piece of landscape in the project, the wall and its surrounding plantings serve no purpose other than to identify the community and signal the character of its residents.

However, all parks do incorporate an element of symbolism. The functions of a park are important, but so is the 'idea' of a park. The hazard, here, is that the idea of the park has traditionally grown out of the functions of the park, and perhaps now subsists on that prior meaning. Unless parks can be designed to accommodate functional and not just symbolic benefits, their role in the life of the community will decline over time.

[24] Putnam, Robert. "Bowling Alone: America's Declining Social Capital." Journal of Democracy, 1995.

Typological Precedents

The treatment of park typologies - particularly historical ones- may seem unnecessary in a work addressing one particular, specified type of park. The other parks in the typology, while interesting, are outside the scope of the research and its conclusions. The benefit of reviewing these systems, however, is to provide a framework for thinking about potential variation in park form. As the appendix listing the study sites suggests, the term 'neighborhood park' as generally accepted encompasses a wide range of possible sizes, treatments, and activities. The effective typology can present all the basic forms of the park, indicating the fixed and variable attributes of each type.

Park Systems

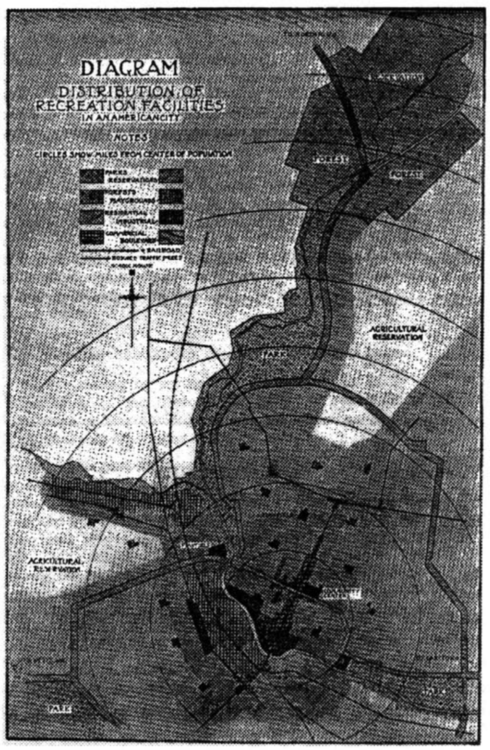
Formal ordering systems were a popular tool for writers of the progressive movement, who sought rational bases for understanding and discussing aspects of the built environment. Parks lend themselves well to hierarchical models in part because the term 'park' is sufficiently broad to encompass mutually contradictory ideas and goals. To respect each of those attributes while preserving the integrity of the grouping requires a formal method of distinction.

The planner and landscape architect Henry Hubbard laid out one such model in a 1922 presentation to the National Conference on City Planning. Hubbard, like any good utopian modernist, proposed a complete system, a tightly interlocked series of parks encompassing all possible needs of a community. (Illus. 1.3) Indeed, Hubbard's largest type, the reservation, included forestry lands and water reservoirs within its borders. By including the pieces of a rationally managed biosphere, Hubbard's system could well spread uninterrupted across the country and beyond. The largest park for active, frequent use was the 'country park,' and met the perceived need for contact with at least the image of unspoiled nature. It provided visitors with solitude, recreation, and a respite from the stressful urban experience.

The 'in-town' park, intended for active use, includes smaller, busier parks, squares and plazas. Play field parks permit 'structured' play by older children. Gymnasia, in contrast, provided space for unprogrammed activities: athletics, calisthenics, or whatever else young men and women might choose to do with their spare time. To restrict their choices somewhat, however, the gymnasia were gender-segregated and physically distant.

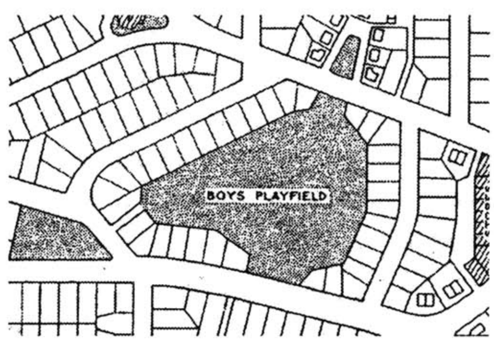
The smallest type of park was the children's playground, designed for children under the age of 12. An attendant would supervise the park, allowing mothers to pursue other activities.

Facilities for specialized sports, like "swimming, skating, curling, lawn-bowls, tennis, baseball and football on full-sized grounds" could be located further apart precisely because their attraction to devotees made longer trips acceptable.

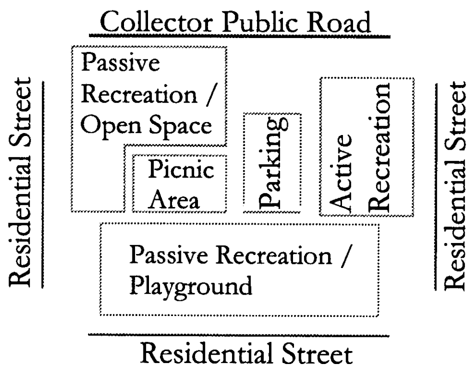


Illus. 1.3
Map of metropolitan area by Hubbard. A civic center anchors the city plan, and small parks anchor each of the neighborhoods. A greenbelt park leads out to forest land and agricultural reservations at the edge of the city.

The list is interesting for both its specificity and its focus. It generalizes ruthlessly about, or neglects entirely, the formal concerns of many designers; plazas, squares and other urban spaces are grouped in a single generic category. Instead, the hierarchy displays a concern with the stages of child development largely foreign to modern parks, which provide activities for a diverse age range. The park system includes the 'ecological park,' the 'tot lot,' the 'gymnasium for unstructured athleticism, girls, ages 12-18,' and so on. (Illus. 1.4) By segregating each possible activity in a separate park, it hopes to provide functional efficiency that matches the system's conceptual clarity.



Illus. 1.4
Playground from a plan by Whitten and Culham in the New York Regional Plan



Illus. 1.5
Diagram of a neighborhood park in the City of Carrollton, per the master plan.

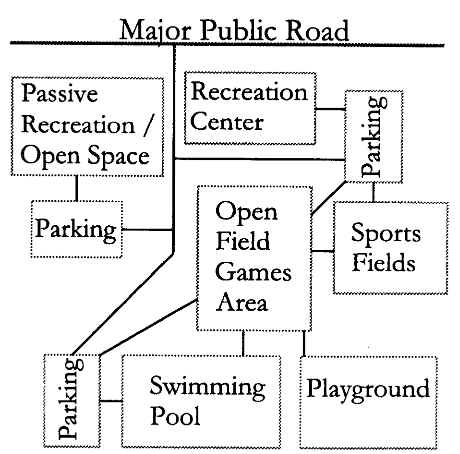
Carrollton and Engineering

In 1975 the City of Carrollton, Texas produced a series of guidelines for the expansion of its park system. In that, and in its 1992 city master plan, it delineated its expected park needs, requirements per person, and typology.

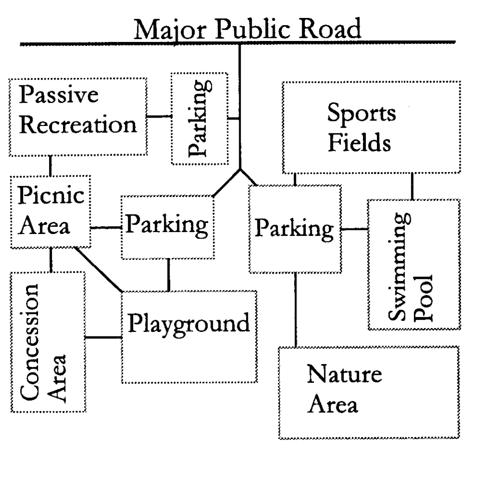
The plan includes six basic types of park with recommended sizes and geographic drawing radii. It lists activities appropriate for each along with diagrammatic designs. The Carrollton plan grows out of conditions common in the Dallas area and many fast growing suburban cities, and the resulting park system resembles those of many of Carrollton's neighbors.

The smallest type in the system, the Neighborhood Park, should ideally be 10 acres, although the City of Carrollton acknowledges that 15 acres may sometimes be required. It serves homes within a half mile radius, an expected population of between 1,000 and 5,000 residents. It includes one 'active' recreation space and, despite its limited drawing area, a parking lot. (Illus 1.5) The vicinity of the neighborhood park should be devoid of major roads, railroad tracks, or other barriers that might prevent children from reaching the park safely.

The Community Park serves a region equivalent to between three and five neighborhood parks, or 6,000 to 10,000 residents. If the neighborhood park's drawing radius corresponds to that of an elementary school, the community park's equivalent is the junior high school. The park's ideal size is 20 to 35 acres, and may include swimming pools



Illus. 1.6
Diagram of a community park in the City of Carrollton, per the master plan.



Illus. 1.7
Diagram of a large community park in the City of Carrollton, per the master plan.

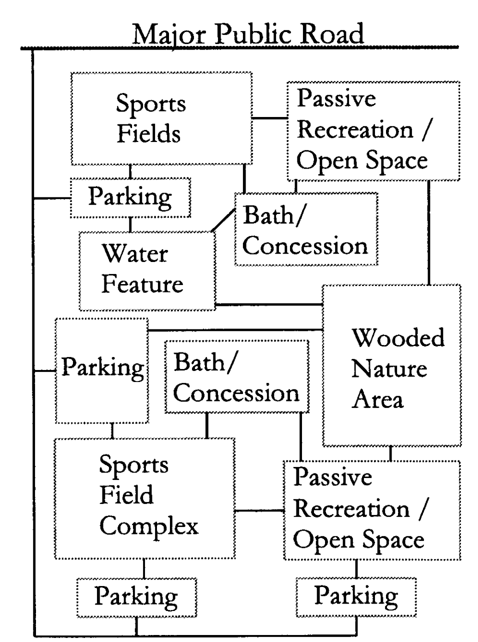
or sports fields. It should have two or more parking lots. The community park can generate negative external impacts - noise, traffic, delinquency - and should be buffered from adjacent housing. (Illus. 1.6)

The Large Community Park, the park system's equivalent to a senior high school, serves an area of between 10 and 25 square miles. Its recommended size is 40 acres, though 30 acres is acceptable under some circumstances. The large community park includes extensive parking, sports fields and facilities, a "nature area" and concessions. (Illus. 1.7)

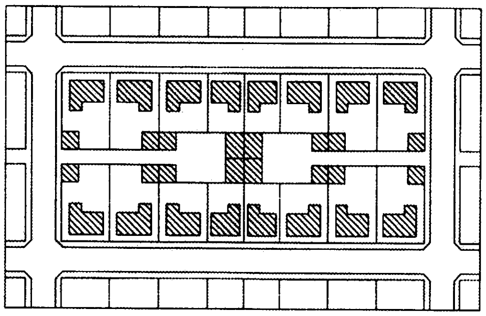
The Metropolitan Park offers, in the words of the Carrollton plan, a "wooded nature area." In addition, however, it provides sports complexes, decorative water features, multiple parking lots, and bathing facilities. The Metropolitan Park's ideal size is 200 acres, and it serves 50-100,000 people. (Illus. 1.8)

Linear Parks and Special facilities are the catchall categories of the Carrollton park plan. Linear parks can be buffer zones, connecting trails, or greenbelts. Special facilities, like botanical gardens or golf courses, finish the system.

The Carrollton hierarchy is an inclusive one, in which each scale of park incorporates all the activities of the smaller parks. In this respect, it is almost



Illus. 1.8
Diagram of a metropolitan park in the City of Carrollton, per the master plan.



Illus. 1.9
'Lane' type from the DPZ typology

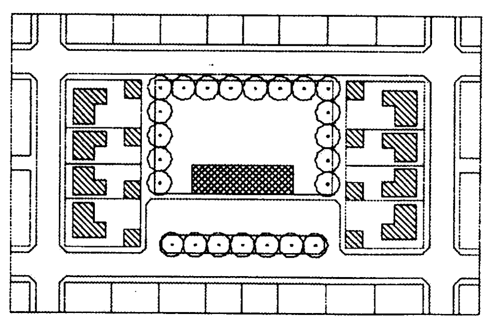
antithetical to the careful functional justification of Hubbard's plan. The scale of the hierarchy is especially problematic for neighborhood parks. The half mile drawing radius encompasses multiple subdivisions. Because arterial and collector roads connect these subdivisions, children will not have a safe path to the park.

DPZ and Traditionalism

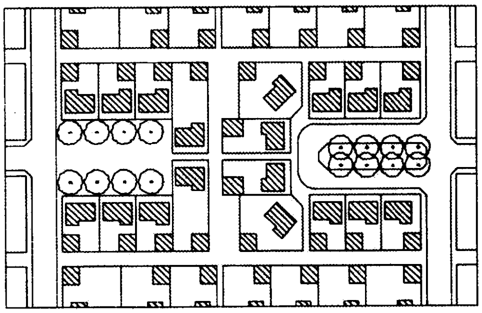
The design firm of Duany Plater-Zyberk (DPZ), a leading proponent of neotraditional planning and design, developed its own categorization of urban parks and open space. More a typology than a hierarchy, it treats the issue of interlocking scales far more implicitly than did Hubbard. The parks have different scales, but no particular arrangement of those scales with respect to one another is mandated. While the specific system is new, its precedents are old, and its inclusion in *Architectural Graphic Standards* will come to give it influence.

The smallest of DPZ's types, the Lane (Illus. 1.9), is roughly equivalent to a mid-block cul-de-sac serving the parking garages of houses fronting onto the street. Like the conventional suburban cul-de-sac, the lane allows a limited access road to be used as a play space. There are two scales of play field, the playground and the "nursery." (Illus. 1.10) The difference here is principally formal, unlike the highly programmatic distinctions of Hubbard.

The term "close" is used to describe what the American Society of Civil Engineers (ASCE) would call an "eyebrow street" or auto court. (Illus. 1.11) Different from the popular suburban 'circle,' the close refrains from building houses within the loop, placing instead a park or green space. By restricting through traffic, closes offer one of the principal benefits of cul-de-sacs, and allow the road to



Illus. 1.10
'Nursery' type from the DPZ typology



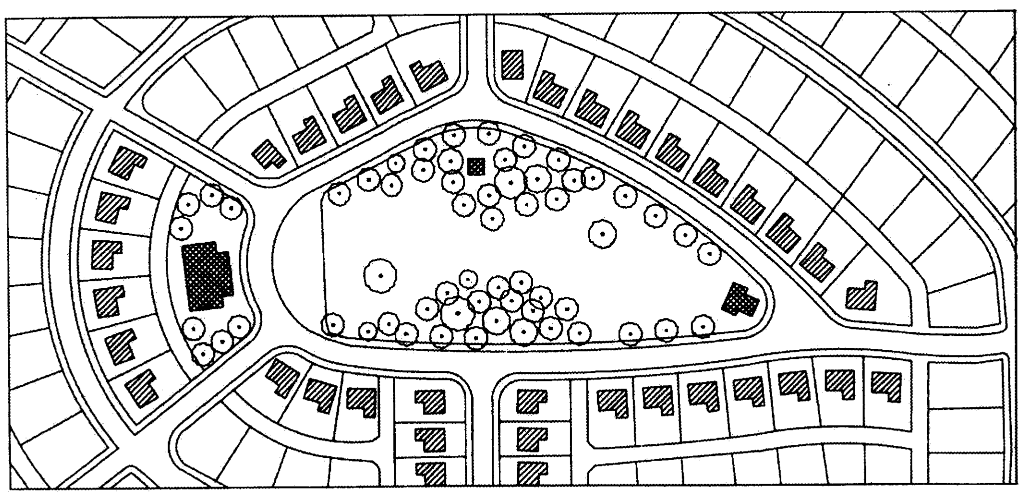
Illus. 1.11
'Close' type from the DPZ typology

serve safely as an extension of the play space within the loop. At the same time, they avoid the cul-de-sac's insularity, and the desert of paving at the cul-de-sacs turnaround.

Attached and detached squares, representing increasing levels of formality, help to focus and orient a neighborhood. Market Plazas and Civic Plazas are commercial types, or at least not wholly residential types. Both of these serve a variety of civic functions, from meeting places to centers of commerce, that are generalized in Hubbard's hierarchy.

The Green, like the Park, is naturalistic in plan, and minimally programmed. The Green exists clearly within the urban fabric (Illus. 1.12) whereas the Park may border the city or town. DPZ's Buffer Park, the last type, serves to negate some aspect of the local environment. In this sense it resembles the greenbelt element of the Carrollton typology, though the Carrollton typology includes allowances for wildlife corridors and nature reserves, while the DPZ type assumes more actively programmed uses.

The simplest kind of detached park, at least in a gridiron, is the replacement of a single residential block by a park



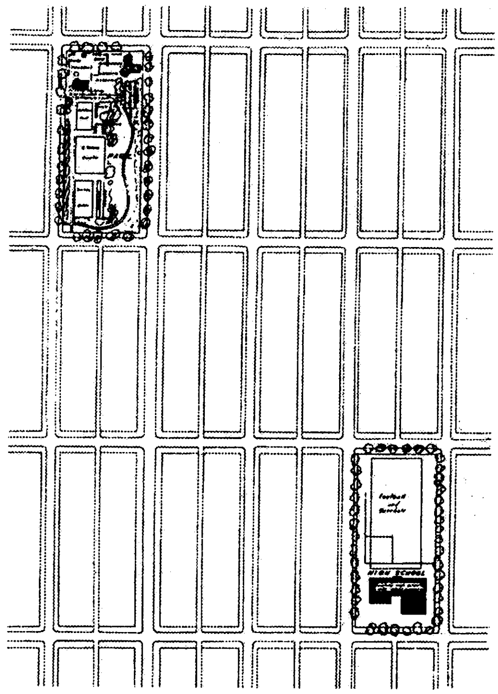
Illus. 1.12
'Green' type from the DPZ typology

of equivalent size. (Illus. 1.13) It is bordered on all sides by streets leading away in both directions.(Illus. 1.14) The plan offers excellent accessibility but the risk of excess through-traffic along the park. If blocks are rectangular, the houses on the narrow end of blocks facing the park will need to be rotated to capture the frontage value.

The next principal type is the offset park, or the Philadelphia square. In this plan, roads intersect the midpoint of each side of the park and a perimeter road provides access. In this respect, the park resembles a traffic circle around which vehicles must be maneuvered. (Illus. 1.15) This model, by closing the corners, provides the strongest sense of enclosure of any of the parks. It terminates four street axes attractively, and eliminates one four-way intersection, albeit with the added expense of four 't' intersections and 4 corners.

The Harrisonburg square type resembles a combination of the Philadelphia and gridiron types. It terminates two streets at the park, but does so without the awkward perimeter road of the Philadelphia square. Unlike the gridiron, the type also provides flexibility in sizing in one dimension. (Illus. 1.16)

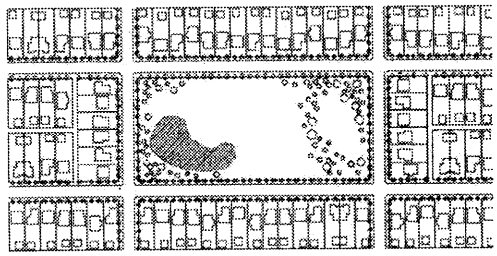
An additional modern type, the pinwheel square, derives from modern sources. (Illus. 1.17) Henry Wright pro-



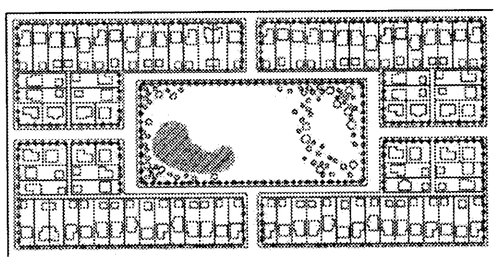
Illus. 1.13
Diagrammatic arrangement of parks by the Denver parks department. Published in *The American City*, 1930.

posed a pinwheel street system in 1930, for example, and DPZ presents a pinwheel plan as one of its basic detached square types in *Architectural Graphic Standards*. The arrangement eliminates four way intersections in favor of presumably safer 't'-intersections. As a result, it terminates four street axes, albeit unconvincingly at the midpoint of a residential block. The pinwheel maximizes frontage around the park by reducing the number of access roads.

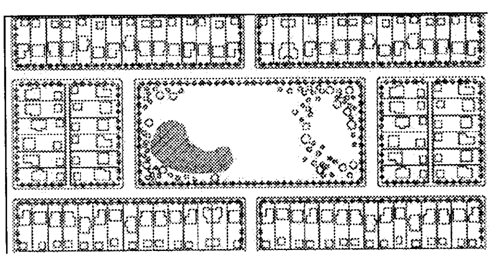
DPZ addresses most, albeit not all, of these detached park types in the *Archi-*



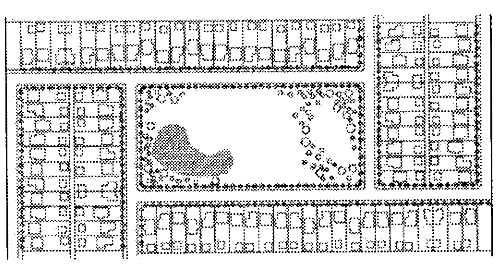
Illus. 1.14
A conventional gridiron square.



Illus. 1.15
The Philadelphia square type.



Illus. 1.16
The Harrisonburg square type.



Illus. 1.17
The Pinwheel square type.

tectural Graphic Standards typology. A number of other types, based on historical squares (Price, 1968) or the Law of the Indies, could also be presented. The defining characteristic of all of the parks, however, is that they require particular arrangements of surrounding streets to be effective, and so begin to imply a city the Carrollton typology does not.

In this way, the DPZ typology is most explicitly spatial in its intent toward the surrounding street plan. It adopts clear positions with respect to the functional roles that each park type plays, and makes effective differentiations within the neighborhood scale. By treating each park as independent of others in the hierarchy, it produces a richer - albeit less rigidly logical - gradation of size and importance than does Carrollton's plan.

Each of the principal park systems implies a very different city. Hubbard proposes an overlapping hierarchy of parks, with a strongly rational aspect. His system, which includes a reservation, exercise fields, and an allowance for unique local areas, is metropolitan in the best sense of the term.

The DPZ typology implies a finely grained, human-scaled urban fabric. It uses carefully chosen names for its parks, names that evoke emotional responses. The parks are less intrinsically interrelated than are those in Hubbard's system.

The Carrollton park plan, with its coarse grain, reflects one's experience of the City of Carrollton itself. It is efficient as a hierarchy. Its interlocking scales seem reasonable, and indeed are not dissimilar from those used by Hubbard. The parks are, however, too large to belong in a neighborhood. They are tears in the fabric of the city, similar to an office park or a strip mall. A 25-acre park and a 40-acre park are not meaningfully different in their effect on the neighborhood. From an experiential point of view, then, the Carrollton park plan has almost no hierarchy at all.

Park typologies provide one solution to the problem of premium dilution. The dilution effect assumes that the marginal value of additional, similar parks in a neighborhood is positive but very low. Once residents have a park within walking distance, the addition of a second park filling similar needs adds little to the quality of life. Parks within walking distance will quickly begin to cannibalize one another's proximity benefits. Those benefits justify the premiums that support the cost of the park, and their dilution is a significant factor.

There are three basic kinds of solution for this problem. First, parks can be located at distances that minimize this rent gradient overlap. This strategy creates neighborhood with few amenities, however. Second, a network of parks can be designed that together meet needs beyond what an isolated park could provide. Third, the designer can differentiate the parks - either formally or functionally - so that their effects are no longer diluted. The parks are no longer substitutes for one another, and the gradients are not diluted. The last of these strategies, the most realistic and easily achieved, is a natural outcome of either the Hubbard or DPZ typologies. If one typology is more concerned with functional benefits and the other with formal properties, both offer a similar level of benefit as design tools.

The Neighborhood Plan

Unfortunately none of the numerous existing paths coincided with the theoretical direction Mathias had selected; he was therefore confined from the start, to one of two possible detours. Besides, every path looked winding and discontinuous - separating, reuniting, constantly interlacing, even stopping short in a briar patch. All of which obliged him to make many false starts, hesitations, retreats, posed new problems at every step, forbade any assurance as to the general direction of the path he had chosen. [25]

Street hierarchies determine the accessibility of parks to nearby residents. The total 'cost' of travel is a function not just of travel distance, but also of the scale of connecting roads, the number of street crossings and intersections, and alternate paths available. The thesis distinguishes between primarily functional versus formal hierarchies. A hierarchy is functional, however, not because of greater practicality, but by being justified primarily in those terms. Indeed, the appeal of a functional plan depends in part - some might say largely - on a strong element of formal clarity.

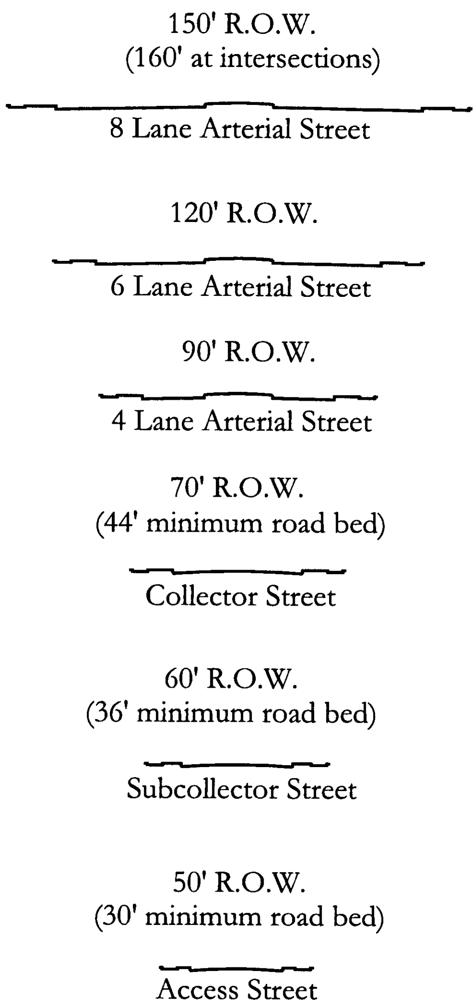
The Rigid Hierarchical Plan

The American Society of Civil Engineers (ASCE), together with the National Association of Home Builders (NAHB) and the Urban Land Institute (ULI), delineate a four-tier hierarchy of street for conventional suburban development. [25] The hierarchy is the basis of most road systems around the study parks and throughout the Dallas region.

The smallest of its street types, the Access street, serves the individual residences and, ideally, no through-traffic. The most extreme example of this is the cul-de-sac, but any small road qualifies. Subcollectors, the next level, serve access streets but also have residences. Collector streets are the primary arteries in individual neighborhoods, and may have commercial uses as well. The arterial is a non-residential street, providing primary access to and from the neighborhood or district.

The City of Carrollton follows this basic hierarchy of streets, at least in theory. (Illus. 1.18) As Ewing (1994) notes, however, few street grids follow

[25] Robbe-Grillet, Alain. *The Voyeur.* Trans. by Richard Howard. New York: Grove Press, 1958, p. 159.



Illus. 1.18
Road Sections from the comprehensive plan of Carrollton, Texas. Unlike traditional street sections that show the relationship of buildings to street, the sheer scale of Carrollton roads rejects graphical representation of space.

[25] See the jointly published work *Residential Streets, Second Edition*, 1990.

[26] See Owens and Southworth (1993) and Southworth and Ben-Joseph (1997).

the implications of this model by reducing access to sites along collector roads or arterials. Instead, roads of different scales all serve as access roads for adjacent uses. Too many turning vehicles reduce the speed of traffic on major roads, and in turn compromise the functional justifications for the hierarchy.

The Loose Hierarchical Plan

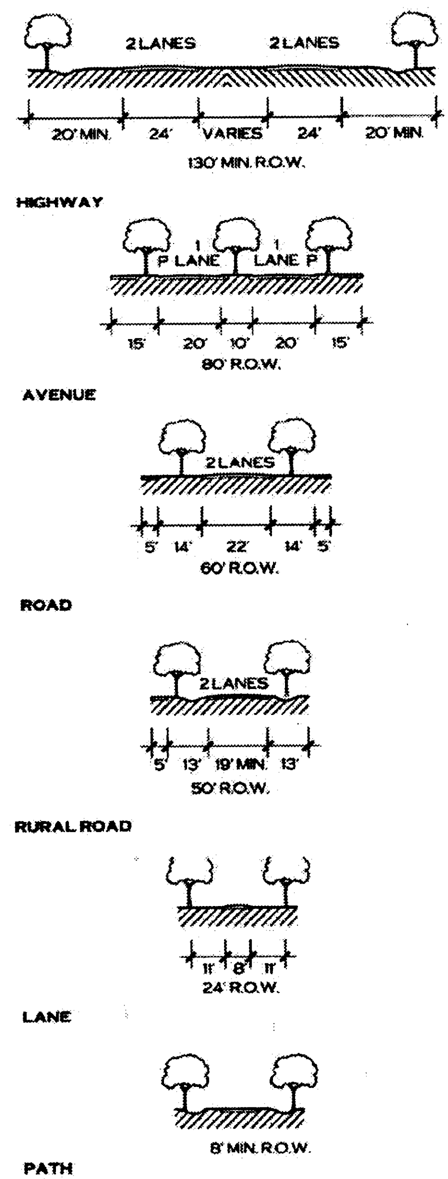
The firm of Duany Plater-Zyberk & Co. delineates road types more exhaustively than the ASCE, and in doing so provide an informal hierarchy that is strong but less rigid than the conventional suburban model. (Illus. 1.19) The DPZ hierarchy divides roads first as being 'more rural' or 'more urban.' The types are distinguished by elements like the curb treatment, expected setbacks of adjacent buildings, and urban precedents. Not included are the cul-de-sac, the court, the eyebrow, or other recent additions to the physical landscape.

In all, the published DPZ typology includes twelve street types, among which are many street and path types that are smaller than those in the Carrollton system. This precludes the kind of rigid implementation possible in a four-type hierarchy. While each street carries implications about the form of the city, town or suburb around it, those implications permit a wide variety of meaningfully different street plans.

Conventional Suburban Grids

In an article with Peter Owen, and later in a book with Eran Ben-Joseph, Michael Southworth has further divided the conventional suburban street grid - the one contained within the grid of collectors and arterials - to include plans popularized since the 1950s. Looked at together, these present the process by which the basic gridiron evolved, or devolved, into current popular practice. [26] All of the principal types are represented in the neighborhood studied, and the accompanying illustrations are taken from municipal plat plans collected during research. Most of the city, however, reflects not even the clarity of the types as presented. While few plans will use a single style exclusively, the formal strategies of each of these types find expression in the arrangement of conventional suburbs. Framed as historical stages in the evolution of the suburb toward a seemingly logical end, the styles retain their relevance to both an understanding of suburbs as they now exist and of the suburbs that are being built today. As presented by Ben-Joseph, Owen and Southworth, the stylistic trends break down roughly by decade.

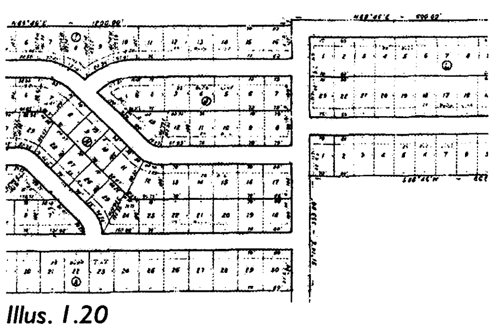
In the 1950s, the fragmented parallels plan tried to capitalize on the infrastructure efficiencies of long blocks, while varying their arrangement to avoid



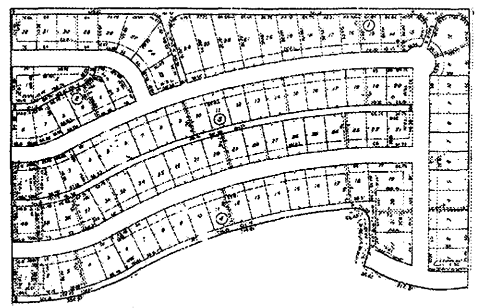
Illus. 1.19
'More rural' road sections from the DPZ typology published in *Architectural Graphic Standards*. The typology also includes 'more urban' road sections.

monotony. (Illus. 1.20) Fragmented parallels reduced the number of four-way intersections, which were blamed for both accidents and congestion. [26] Any plan relying on uninterrupted blocks to increase site efficiency reduces sharply the value of pedestrian amenities unless blocks are provided with pedestrian paths. Since few neighborhoods were provided with such paths, this search for a more efficient street grid hastened the decline of walkability in suburban neighborhoods.

In the 1960s, the warped parallel superseded the fragmented parallel type. (Illus. 1.21) In addition to its presumed other charms, the curving roads in warped parallel plans resolved the problem of oddly closed axes common to fragmented grids. Rather than terminating axes at whatever homes happened to line up with a street, the warped parallel plan prevented the axis from closing at all.



Illus. 1.20
'Fragmented Parallels' plan near Rhoton Park in Carrollton, Texas

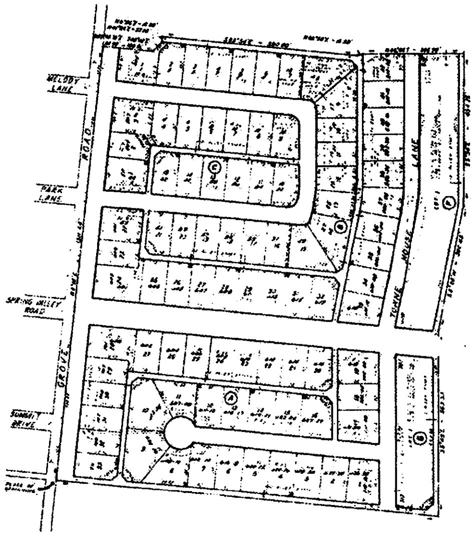


Illus. 1.21
'Warped Parallels' plan near Rhoton Park in Carrollton, Texas

The 1970s saw the development of the so-called "loops and lollipops" plan, which included the cul-de-sac as an integral part of the street design. (Illus. 1.22) Developers in the 1980s brought the cul-de-sac to its logical conclusion with the "lollipops on a stick" type. (Illus. 1.23) This is the most extreme realization of the hierarchical street system applied to the neighborhood scale. Access roads and collectors roads are painfully separate

The types presented by Ben-Joseph, Owens and Southworth, and their gradual evolution over time, are a cautionary tale for design and real estate research. The plans resulted from the careful consideration of a limited set of variables - in this case, principally the reduction of initial, localized infrastructure cost and the elimination of the perceived hazards of through-traffic and four way intersec-

([27] Tunnard and Pushkarev, p. 151.)

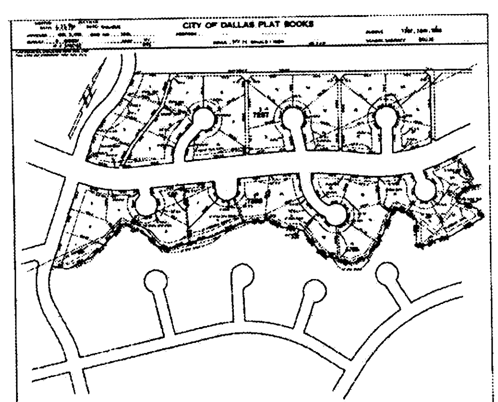


Illus. 1.22
'Loops and lollipops' plan near Woodhaven Grove Park in Richardson, Texas

tions - and the optimization of neighborhoods and cities with respect to those variables. That the result is unsatisfactory and unsustainable should be unsurprising; the variables in question are not in the end sufficient to measure the underlying qualities they profess to care about.

A review of Carrollton's model, and of the road widths deemed necessary to support it, indicates the fundamental limitations of the hierarchical, dendritic street grid for vehicular travel. Such grids were intended to be exclusive hierarchies, in which each kind of road served the particular functions for which it was best suited. "The next problem, and a very important one, is to express *with absolute clarity* the functional hierarchy of the street system."[27] (Emphasis added) In practice, however, subcollector and collector streets sprout curb cuts, first opening onto driveways and later into shopping centers. The few pedestrians, not provided with grade-separated crossings, must use these streets as well if they wish to travel anywhere. The system becomes instead an inclusive hierarchy, in which each street encompasses the functions of every smaller kind of street.

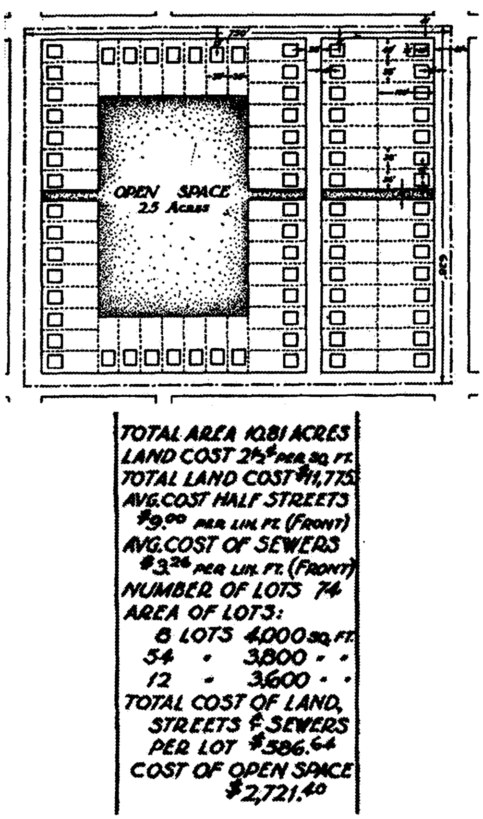
The system, which rapidly produces uncrossable roads, affects the viability of small-scale, pedestrian friendly amenities like parks, as will be discussed in Chapter two. When those residential street systems are placed within an arterial system, it further diminished the value of those amenities. Its adoption was part of a general abandonment of walkability as a key attribute of neighborhood, in favor



Illus. 1.23
'Lollipops on a Stick' plan near Pagewood Park in Dallas, Texas

of minimization of street infrastructure and an emphasis on lowest first cost development. (Illus. 1.25)

The DPZ model, or any plan utilizing traditional rather than conventional street types, suggests the alternative. Streets are distinguished as much by their particular experiential character as by their traffic carrying capacity or placement in the hierarchy. As even the most significant streets in the model are intended for frequent pedestrian use - indeed, many of the largest streets are precisely those most likely to attract pedestrian use - neighborhoods comprised of them will have no major barriers to pedestrian travel. Finely scaled streets, too, imply a finely grained city. The streets must be placed more frequently to absorb the same rush hours as a large hierarchical grid. By making the grid more fine, however, those streets make pedestrian travel more efficient and more pleasant. In the context of a neighborhood that provides necessary, frequently used services nearby, a finely grained street grid may simply not need to support the same volume of traffic.



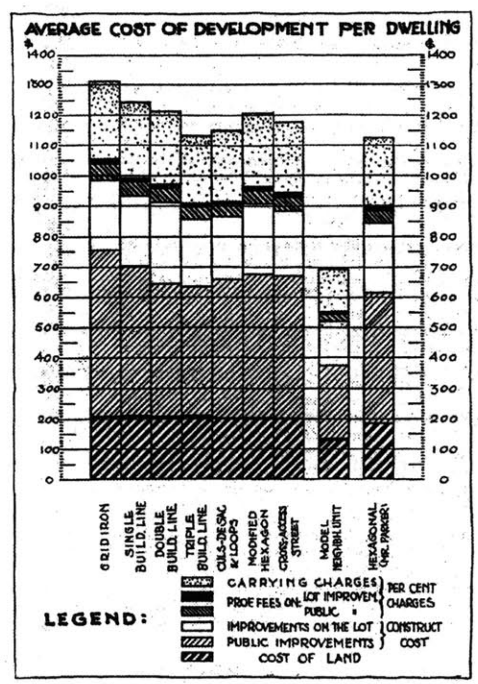
Illus. 1.24
One of numerous analytical plans in Adams' book *The Design of Residential Areas*.

The repugnance for the 19th century gridiron came in part from a belief that the suburb was an antidote to city life, and so must oppose it in form as in character. To many designers and planners, the gridiron represented planning's absence. As the 'default' form for new tract development, it was a refuge for the least reputable forms of practice, in much the same way as the cul-de-sac development is today. Many progressives included in their work data sheets presenting itemized development costs for different designs. (Illus. 1.24) They tried to isolate the physical characteristics of efficient infrastructure, and to derive from that an optimal strategy for neighborhood design. By presenting highly speculative cost trade-offs in clear, black and white terms, rationalized design strategies encourage precisely the linear thinking planners decried in the gridiron plan. Cul-de-sacs and hierarchical street grids, after all, were first advocated by the most responsible, thoughtful planners and advocates as a solution to problems of housing affordability, safety, and community. Only afterward have they acquired a connotation of bad, shortsighted development practice.

The effect, of course, was to replace one dreary, repetitive street plan with another. Neighborhoods reduced to residential monocultures - with supporting uses clipped along adjacent, unwalkable arterials - have proven unsatisfying regardless of their precise shape. At the same time, the evolution of street plans to minimize initial paving requirements and reduce through-traffic has neither cut the cost of suburban development nor made neighborhoods pedestrian-friendly.

Conclusions

The principal distinction in all the systems is between exclusive and inclusive hierarchies. Inclusive, or rigid, hierarchies, those in which each a facility belonging to any level encompasses all the attributes of facilities on the levels below it, produce a very wide range of scales. The hierarchy is easy to understand, and evokes a strong sense of planning. The limit of a park's effectiveness, however, depend not on its operational logistics or on the acquisition of very large parcels, but on the degree to which that park resonates with its users. The largest parks in an inclusive hierarchy may be technically efficient, but do not relate to the scale at which people understand their community or neighborhood.



Illus. 1.25

Chart from Adams, 1934, p. 217. Mild variations in construction cost for the different unit types are well within the standard of error common to any development project. The chart, in short, demonstrates nothing, scientifically.

An exclusive, or loose, hierarchy, in contrast, acknowledges differences in the importance of different elements, but does not specify a formal relationship among those elements. An exclusive hierarchy will tend to produce a much wider variety of facilities of far more similar scale. This scale is closer to the scale at which people actually experience the environment, and so will produce a richer, more stimulating environment even if the number of items in each hierarchy are the same.

The value of a park to residents depends on individual factors rather than its location in a hierarchy. The scale at which many of those factors - pedestrian accessibility, community preferences, physical safety - must be addressed is very small. A flexible, loose hierarchy is more valuable to designers and developers because it provides more, and better, options for individual design problems at the scale of the block, street, or neighborhood.

2

One starting point of the thesis is thatdevelopers, using conventional standards and methods of assessment, will be disinclined to provide parks in new neighborhoods. Neighborhoods without parks are simpler to design and construct, and their financial performance is easier to predict using widely available rules of thumb. Regardless of whether the financial benefits of a park will ultimately outweigh its cost, the difficulty of calculating those benefits in advance makes the park a costly, risky amenity. [1] Because of this, residents in conventionally developed neighborhoods will have less access to recreational park space, and to the environmental and social benefits of parks, than they might actually desire.

The difficulty of providing such amenity space is in part a function of a park's nature as an economic good. Publicly accessible, privately funded parks present a free rider problem; individual users have an incentive to avoid contributing to the cost of their provision, if doing so will not restrict their use of the amenity. The economist Mancur Olson has referred to this as the latent interest group problem. [2] No single party in an environment of fragmented land ownership receives enough benefits from a park to justify providing that park independently, and no party wishes to contribute to a common pool for the provision of the park without assurance that other parties will contribute as well. The rational interest of each landowner, however, ensures that they will not. For these reasons, fragmented land ownership will be unlikely to produce privately financed

[1] In addition, many cities have regulations that specify requirements for parks: acreage, parking requirements, wide perimeter and access roads. These regulations make economically viable parks difficult to provide. Zoning variances from these restrictions are costly and time-consuming to obtain.

[2] Olson (1965)

parks without coercion, even though each of the individual landowners might support the provision of parks.

In part for this reason, treating the current frequency of parks in housing subdivisions as a reflection of consumer preferences will underestimate the net demand for park space among residents, implying insted that private yards are the principal kind of open space demanded. One would reach this conclusion despite the fact that public parks have substantial economies of scale that make them both more efficient - in the sense of providing a larger absolute level of utility per dollar invested - and more desirable for many activities than private lots.

Private ownership of many kinds of goods is efficient, because the owners of those goods have a greater incentive to manage and preserve that good than would any individual in the case of group ownership. Publicly held parks, however, provide benefits that cannot be duplicated easily in private yards. For this reason alone, one would expect to see at least some publicly accessible park space in many or most new suburbs. The bias of conventional suburbs in favor of privately held outdoor space represents as much an economic problem - how to distribute the costs of an amenity among the people who actually use and benefit from that amenity - as it does a real preference for privately owned outdoor space over public park space.

Parks, like other publicly accessible civic amenities, have conventionally been classified as public goods in the economics literature. However, parks also display many elements of private and so-called 'club' goods as well. To clarify some issues associated with the behavior of parks in neighborhoods, and to explain in part their scarcity in conventional suburbs, this section includes a simple review and application of some aspects of these theories to neighborhood parks.

Public Goods

"By the orthodox definition a pure public good or service is equally available to all members of the relevant community...Once produced, it will not be efficient to exclude any person from the enjoyment (positive or negative) of its availability."[3]

Public goods are those for which discrimination among users is impossible. Public goods epitomize the conflict between the rational self-interest of the individual and the collective good of the community. While the total benefit to society provided by a public good is large enough to justify its cost, the benefit accruing to any one individual is not high

[3] Buchanan, James M. The Demand and Supply of Public Goods. Chicago: Rand McNally & Company, 1968, p. 49.

enough to induce that individual to provide the good. Every individual would benefit from the good, but it is in the rational interest of no individual to provide it. As cost rather than profit centers, public goods will tend not to be provided without the involvement of public agencies.

Illus. 2.1
A conventional separation of public park space from adjacent neighborhoods.

The goods that best meet the definition of a public good are those with diffuse benefits, like national defense, or with ideological benefits - pride, status, reputation - like some public improvements. Adam Smith, for example, saw symbolism and recreation -principal benefits of parks - as among the few virtues that justified public involvement in markets. "Lands for the purposes of pleasure and magnificence- parks, gardens, public walks, etc., possessions which are everywhere considered as causes of expense, not as sources of revenue- seem to be the only lands which, in a great and civilised monarchy, ought to belong to the crown."[4] Even libertarians like Milton Friedman wavered on the effectiveness of the private market when it came to distributing the cost of urban parks: "For the city park, it is extremely difficult to identify the people who benefit from it and to charge them for the benefits which they receive. If there is a park in the middle of the city, the houses on all sides get the benefit of the open space, and people who walk through it or by it also benefit. To maintain toll collectors at the gates or to impose annual charges per window overlooking the park would be very expensive and difficult."[5] Faced with what he thought a non-excludable good, Friedman advocated public involvement to ensure that necessary goods and services were provided.

This interpretation of how parks behave has led cities and counties to assume responsibility for their provision, and in doing so to discourage private landowners from doing the same. Unfortunately, the biases of public agencies, which encourage large, consolidated parks with low maintenance costs, and conventional patterns of land development, which favor very large subdivisions that make outside amenities inaccessible, have produced the current scarcity of accessible park space. (Illus. 2.1)

[4] Smith, Adam. An Inquiry into the Nature and Causes of the Wealth of Nations. 1776, Part V, Chapter I.

[5] Friedman, 1962, p. 31.

If the problem of free riding by rational landowners implies that neighborhood parks are best provided by public agencies, the economic behavior of parks, and the incentives of those agencies, do not. Cities lack both methods by which to evaluate the behavior of park and the incentive to find value-maximizing rather than cost-minimizing solutions. Regional parks with very large drawing radii, in contrast, are a more appropriate focus for the intervention of public agencies, because those facilities are more likely to produce negative effects in their immediate vicinity. [6] Increased traffic, noise, litter and the presence of more strangers around are all disamenities that will tend to depress the value of homes in the immediate vicinity of a large park. Homes further away from the park, which are close enough to be accessible but far enough away to avoid disamenity effects, will receive proximity premiums, while adjacent houses may sell for no premium or at a discount (Weicher and Zerbst). For an economically efficient park, the sum of benefits to users and homeowners created by the park will outweigh the sum of costs generated.

A developer must capture enough of the price premiums created by a park to recover not just its cost but any possible price discounts generated by that park. Providing a large, specialized park as part of a small development may diminish the value of adjacent lots, belonging to the developer of the park, while benefitting only abutting landowners. For this reason, large parcels, which can encompass not just the immediate zone of disamenity effects around the park but the zone of positive proximity gradients beyond that, will be more likely to support large, specialized facilities. Alternately, private landowners can provide amenities that, either through their scope or their design, produce no local disamenity effects. This may be either because they do not attract visitors from outside the neighborhood or because they limit the activities that can occur in the park.

Buchanan noted with respect to public goods that, "(s)trictly speaking, no good or service fits the extreme or polar definition in any genuinely descriptive sense."[7] The public good in its purest form does not permit discrimination among users. While the park as a whole may be publicly accessible, access to many individual attributes of the park, indeed the attributes that are most valu-

[6] See Thibodeau (1990), Li and Brown (1978) and Waddell, Berry and Hoch (1993) among others.

[7] Buchanan, 1968, p. 49.

[8] Sandler and Tschirhart describe a club as "a voluntary group deriving mutual benefit from sharing one or more of the following: production costs, the members' characteristics, or a good characterized by excludable benefits."

able to many residents, can indeed be controlled. For example, the value of a park to residents depends in part on that park's accessibility. This value will then decline as travel distance rises, and impose an implicit limit on the drawing radius of the park and its potential users. A developer who owns the land within effective travel distance of the park - that distance which justifies actually going to the park for a typical resident - can effectively regulate the user base of that park. Buchanan appears to have been referring principally to parks in dense urban neighborhoods, where consolidated land ownership would be impossibly costly. Generalizing from urban to suburban environments would in this case result in mischaracterizing the basic economic performance of the good.

In light of this constraint and others, parks resemble more closely the 'club good', which occupies a conceptual middle ground between the public and private spheres.[8] While not all the attributes of a club good affect a suburban neighborhood park, it provides a more constructive way of thinking about the issues involved.

Congestibility, for example, is a characteristic of both club goods and of parks. Too many users of a park facility will degrade the quality of each user's experience and ultimately the physical infrastructure of the park. Practically, however, the low densities in conventional suburban neighborhoods mean that parks are unlikely ever to reach the point of degradation from overuse. Urban residential density levels and family size have both declined throughout the century, and a wide variety of electronic pastimes now occupy children who might otherwise be out in the streets. Indeed, too few users - which results in the park feeling and perhaps being unsafe - are a more likely problem than too many. In this case, conventional models of congestion would be inverted; more users would make the park more valuable to each user rather than less.

Club goods must have excludable benefits, however, even if congestion is not a primary concern. The ability to deny access to the good to those who do not join the club (contribute toward the good) is essential to avoid free riding. Though Friedman noted the difficulty of direct control of parks, it has been used successfully in some cases. Gramercy Park in New York, for example, is famously off-limits to non-residents, while residents around Louisburg Square in Boston jealously guard the keys that are their symbolic right of access to a largely symbolic park. A better way to think about parks in this context is not as single entities to which access is controlled but as bundles of goods, access to each of which may be controlled separately. These can include both active benefits of use and passive benefit derived from walking or driving by the park. In this way, access to one aspect of the park's benefits that can be controlled serves as a proxy for access to other attributes. In large subdivisions, or when looking at amenities like neighborhood parks that have very confined drawing radii, distance will prove the principal barrier. The cost of travel to the park for people from outside the neighborhood will trump the theoretical right of access, and use of the park will be confined to residents of the neighborhood who, presumably, can be compelled either directly (through dues) or indirectly (through higher home prices) to pay for the cost of the park's maintenance.

Membership in an economic club is voluntary. While use of the related good may be possible only with membership, individuals can choose not to join and therefore not to join. This, however, requires in turn that individuals have other options available to them besides membership. The Tiebout hypothesis argued that a region composed of many diverse municipalities, each of which provided a different set of goods and services to its residents, could be economically efficient even though residents of any municipality has no choice about the goods that municipality provided. Given costless mobility, people would, over time, sort themselves out based on their preferences, each person or family choosing the municipality to live in that provided them with the appropriate mix of goods and services. Each municipality would function in effect as a voluntary club to which one could belong by moving within its city limits.

Subdivisions can be understood in a similar way. Even though a buyer of a home in any given subdivision or neighborhood may have no choice in the amenities provided with that subdivision and the costs associated with those amenities, the buyer can choose to buy a home in a development whose mix of amenities best approximates his or her preferences.

This, however, requires that a meaningful choice exist for that buyer. If a region's housing market comprises solely cookie-cutter subdivisions of identical houses and no amenities, the homebuyer's choice is no longer voluntary. The best the buyer can do is to price discriminate among a number of bundles that may not be desirable. Markets for club goods must offer options or alternatives

[9] See Duany, Plater-Zyberk and Speck (2000) and Alexander (1977), among many others.

in order to be efficient.

If the Tiebout hypothesis held true, however, a series of wholly homogenous neighborhoods could be an economically efficient model for development, if collectively those neighborhoods provided a diverse range of housing amenities. The reason it is not relates to the Tiebout hypothesis' simplifying assumption of costless mobility. Homeowner preferences change constantly as families grow and age. Far from providing a stable, efficient equilibrium, a metropolitan region comprised of homogenous neighborhoods would require very high levels of mobilities to even approximate efficiency.

Residential mobility, however, is far from costless. It imposes extensive search costs of both money and time, physical expenses associated with moving, transaction costs, and major costs in the loss of social networks and community. The last of these items is an especially significant cost. A study by DiPasquale and Glaeser (1998) found that a substantial portion of the difference in social capital between homeowners and renters was due simply to length of tenure. Neighborhoods that implicitly assume the Tiebout model, by providing housing appropriate to only one household type, sacrifice much if not all of their residents' social capital by effectively forcing them to move. In contast, neighborhood that provides a range of amenities, appealing to different market segments, demographic groups, and socioeconomic bands, allows residents to stay in that neighborhood and preserve their social networks even as their preferences and needs change. [9]

The problem with neighborhoods that provide a diverse range of amenities, however, is inefficiency. Amenities that appeal to only one part of the population are provided to all. While a homogenous neighborhood can surround its amenities with residents who value, and will pay premiums for, precisely the amenities that the neighborhood has to offer, many of the residents of a diverse neighborhood will value, and pay a premium for, only some of the amenities.

One benefit of parks, or any spatial amenities, is that they inherently acknowledge a range of preferences for access to the good. Residents locate with respect to a park based on the value they place on that park, and pay for that location according to the corresponding proximity rent gradient. In that respect, parks are an amenity uniquely suited to diverse, economically efficient neighborhoods. Whereas the Tiebout model of municipal services assumes that the full spectrum of preferences for a particular good - school quality, say, or restrictions on trade with Burma - are distributed in different municipalities across a metropolitan region, parks and other location amenities accommodate the full spectrum of preferences with respect to a good in the rent gradient around that good. People who like parks and are willing to pay for them will choose to pay the premium needed to live nearby, whereas those indifferent to parks will save money by living farther away.

Residents are likely to differ in more than simply their preference for proximity to parks, however. The value they place on parks in general, and on the specific facilities in the park they choose to locate near, will correlate with other preferences for housing stock. An otherwise homogenous neighborhood is unlikely to capture the full benefits of a park's proximity gradient. More likely is that some of the parcels will be less attractive than others to the target market, by virtue of having too little or too much access to the park. In contrast, if the only amenities in a neighborhood are those that apply uniformly to all residences in the neighborhood, homogenous neighborhoods may capture the benefits of those amenities more effectively.

When not just parks but the benefits of particular kinds of parks are considered, the case in favor of the efficiency of diverse neighborhoods becomes stronger. A stylized park might for example offer two amenities - a pond and some tennis court - the proximity rent gradients of which are likely to differ. Homebuyers now assess not just the overall value of proximity to the park but the relative value of each of the amenities in selecting an optimal location. However, these homebuyers will be unable to select proximity to one of the attributes of the park at the expense of the other. Residents of limited means who value only one attribute of that park may be denied access to it, because it has been bundled with another attribute they do not desire and cannot afford.

If instead two parks, each with one of the attributes, are located near one another, residents can locate themselves more precisely with respect to their individual preferences. Indeed, most parcels in the neighborhood surrounding those parks would have not just different amounts of the two goods (proximity being a good) but different ratios of those goods to one another. A prospective homebuyer could choose among multiple parcels with different associated proximity goods but of equivalent cost. A neighborhood with even a simple distribution of spatial amenities will support multiple household types better than a neighborhood without spatial amenities or one in which all amenities have been consolidated in a single facility.

Consolidating attributes of a park system in a single place will deny some residents access to their preferred amenities, and will force almost all residents to pay for some attributes that they do not personally value highly. This suggests that an efficiently designed neighborhood would incorporate a series of small parks, each providing a few uses that complement one another in the utility functions of likely homebuyers. Unbundling of the attributes of the centralized park in this way promotes an increase in welfare for most of the residents of the community.

These same arguments apply to all the other spatial amenities that together support a neighborhood. Schools, shopping centers, churches, and community centers all have proximity effects, and the way in which the associated rent gradients overlap will determine the distribution of residents within the neighborhood. As with attributes of the park, decentralizing these facilities will accommodate a wider range of household preferences. This does not mean that all facilities should be distributed evenly throughout the neighborhood, however. For some facilities, those that generate agglomerative economies, clustering may be most efficient. Retail stores are an example of this. The benefits of trip consolidation, and of shared parking, outweigh any reduction in household location choice. The benefits of consolidation for park facilities, however, is clear only on the cost side; The benefits to users of large, multiple-function parks are less clear.

Popular rhetoric often supports the conception of parks as public goods, freely accessible to all. Parks, however, are not public goods or public amenities in the pure sense, and treating them as such, even by default, will produce inefficiently planned neighborhoods. The practical limitations of travel distance, limit the area of influence of many of a park's attributes, more closely resemble an economic club. Parks conceived of and designed as economic clubs may avoid moral hazards associated with most public goods.

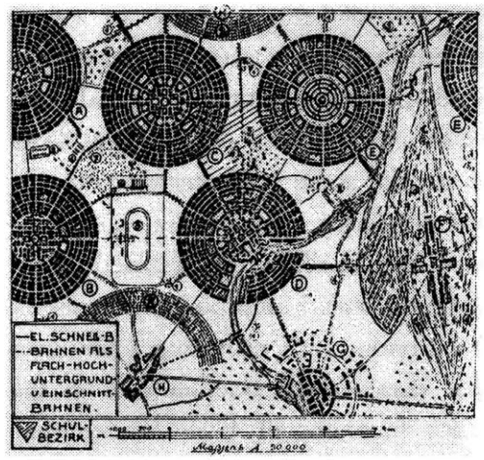
Understanding parks as exclusionary, however, requires careful thought about the preferences and behavior of users. Parks serving homogeneous clubs can respond to specialized preferences easily, providing a range of value with respect to proximity. If an otherwise homogenous market varies only with respect to its preference for proximity to neighborhood amenities, a homogeneous club may be economically efficient. Otherwise, however, some lots will provide inefficient combinations of housing services and spatial proximity.

A system of parks in a heterogeneous neighborhood, in contrast, must meet a wide array of preferences and provide a range of value to different users. While more difficult to design, the value of that park system will be, like any diversified portfolio, more predictable with respect to initial price and more stable over time than comparable parks serving a homogeneous market.

Of course, proximity preferences apply to all location-based goods and not just parks. A strong preference for access to a particular park carries with it an implicit valuation of access to other amenities outside the neighborhood. Cities comprise networks of overlapping clubs, and so a resident who locates near the edge of a park's drawing radius may simply be expressing a preference for other, non-measured amenities outside the study area. For this reason a theoretical location model that treats too few variables may underestimate the importance of its principal variables. Indeed, each of the parks in a system of functionally diverse parks will exert a different pull on the sympathies of residents, and correspondingly command different premiums. It is the interaction of all those benefits, and the preference of residents for each, that will determine the distribution of property values in a neighborhood.

Central Place Theory

Central Place Theory, based on the

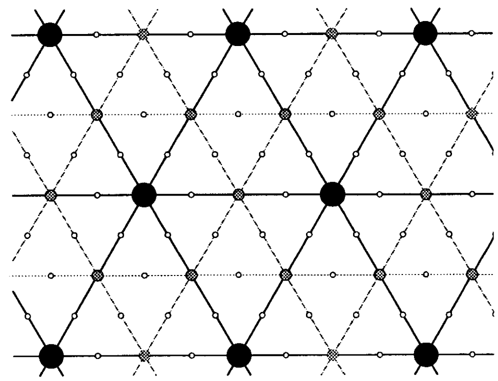


Illus. 2.2
'Nuclear town' proposal by Ernst Gloeden, 1923. Cited in Galantay. While the plan differs somewhat from central place models, because centers are assumed to be constant in size, it shows a similar intuition as to how those centers would distribute in the landscape.

work of the German economist Walter Christaller, argue that the size of towns, and the spatial relationship of towns of different size in the landscape, is a function of the range of goods or services that could be acquired in each. [10] Smaller towns, spaced more frequently across the landscape, offered a limited selection of frequently needed goods. Larger centers, less frequently located, provided those same basic goods as well as a selection of more specialized services and products.

[10] Christaller, Walter. Central Places in Southern Germany. Translated by Carlisle W. Baskin. Englewood Cliffs: Prentice-Hall, Inc., 1966.)

This framework implies that towns of different sizes will form an interlocking hierarchy in the landscape. This hierarchy will provide the full range of required goods and services to a population based on the frequency with which those goods are needed and the corresponding willingness of residents to travel to acquire those goods. Major centers, for example, will arise at a particular spacing, and new centers arise at the midpoints of the roads connecting those major centers. (Illus. 2.2) These smaller centers themselves acquire subcenters, and so on. Hexagons approximate the shape of a theoretical rent gradient around an amenity, and produce interlocking shapes, each with a consistent relationship between center and periphery. The urban grid comes to resemble a series of interlocking triangles of progressively smaller scale. (Illus. 2.3)

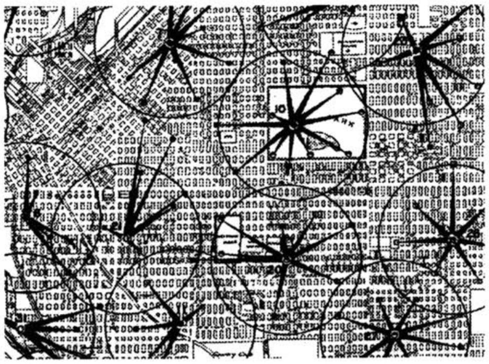


Illus. 2.3
Schematic diagram of central place-based urban area. Larger, darker circles represent larger centers.

Central place theory implies that subcenters near major metropolitan centers will offer a smaller range of goods and services than those located further away. The great drawing power of the central city siphons off episodic purchases (shoe repair, furniture stores, specialty clothing retailers and the like) that would otherwise occur in the neighborhood or town. In this way metropolitan centers attract urban complexity away from surrounding towns. If this were true, one might expect to see a ring of predominantly residential neighborhoods surrounding a central business district, and reliant on that center for goods, services and employment. Outside of this would be a ring of larger centers, offering some or many of the services provided by the downtown core. If this pattern were to grow, traffic patterns to and from these peripheral service districts would increase, and the monocentric model of an industrial city would give way to a polycentric model, much like the 'edge cities' of today that grow around traditional CBDs.

A central place model for parks

Many of the same principles that underlie a central place model for the distribution of urban centers apply to park systems as well. The City of Carrollton's inclusive hierarchy of parks is

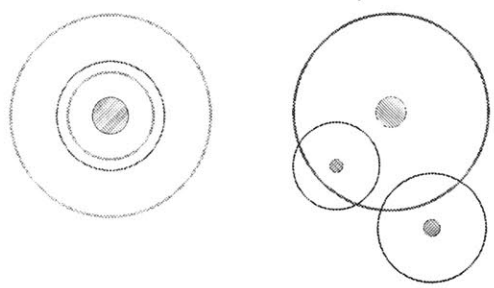


Detail of plan showing the distribution of neighborhood facilities in Denver's gridiron plan. From park system plan published in De Boer.

an example of this. Smaller parks serving common needs of the community are located relatively frequently throughout the city. Larger parks, which contain both the same basic functions as the neighborhood parks as well as more specialized facilities, will be less common. Residents use the specialized facilities less often, and are therefore willing to travel further to reach them on those occasions when they do. The park plan comes to resemble Illus. 2.3, in which large parks accommodate specialized services and small parks accommodate daily needs.

Central place models differ from the park systems of Hubbard or DPZ, however. Those are non-inclusive hierarchies, in which the facilities of common neighborhood parks need not be and often are not duplicated in parks with other, more specialized functions. The drawing radii of different attributes of a center in an inclusive hierarchy will overlay one another, forming what might be conceived of as concentric rings of influence for each attribute around that park. Facilities duplicated in smaller parks would have smaller drawing areas, while specialized facilities would attract users from a larger area In a non-inclusive hierarchy, in contrast, drawing radii of different facilities will overlap based on the relative location of parks serving different functions. (Illus. 2.4)

The optimal arrangement of amenities in a neighborhood depends on the effective drawing radii of each amenity and on how effective proximity works in street plans. In particular, an awareness of how street patterns work to the benefit or detriment of proximity will help designers and developers to maximize the value of different park facilities and to ensure that all parts of a neighborhood are served effectively.



Illus. 2.4

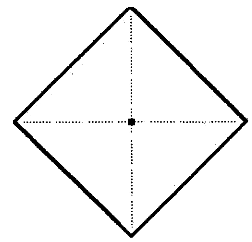
Consolidated park services (left) versus distributed park services (right). The distributed model is more flexible, and can offer properties that appeal to a wider range of household types.

Diagramming Rent Gradients

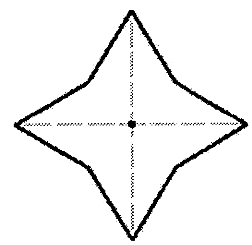
The basic model of a rent gradient in a gridiron plan (Yinger, 1993) begins with one central point, located at an intersection in a grid of equally spaced streets. (Illus. 2.5) Points of equal travel time from this central point are connected with a line, forming a diamond-shaped transportation contour. If roads in the gridiron permit different travel speeds, Yinger demonstrated that the gradient form will distort to reflect actual travel time rather than physical distance. (Illus. 2.6) Diagonal arterials have a conceptually similar effect, reducing travel distance by the difference between the sum of the axial path and the length of the diagonal. (Illus. 2.8)

The physical distance that is the subject of Yinger's diagram will correspond to travel time and cost, the truly relevant variables, only in the unlikely event that traffic is evenly distributed across the grid. In reality, roads, population density and the impact of socioeconomic factors also affect travel time, cost, and aggravation. Unless the dominant mode of travel is by foot, the relevant metric for evaluating central places is not geography but travel time and expense.

Pedestrian transportation cost contour models are in part less complicated because they assume that travel speed

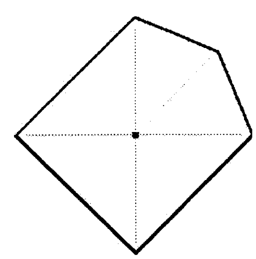


Illus. 2.5
Iso-transportation cost contour in a generic gridiron plan. In this model, travel distance is the only component of transportation cost.

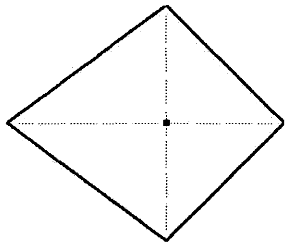


Illus. 2.6
Transportation cost contours with varying arterial speeds. In the illustration, cardinal streets leading from the central point have higher travel speeds than secondary roads.

Illus. 2.7
Transportation cost contours with constant travel speed and a bias in favor of straight paths. Complex paths increase the perceived travel distance and travel cost. The form of the model resembles Illus. 2, but the meaning is different.



Illus. 2.8
Transportation cost contour with gridiron and one diagonal boulevard. Travel distance is the only variable in this model.



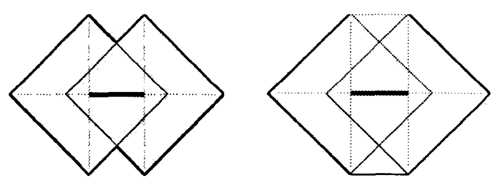
Illus. 2.9
Transportation cost contours with a bias toward frequent destinations. This model assumes that perceived travel time declines with familiarity. In this illustration, the destination would be to the right of the image. The transportation contour distorts in the direction away from centers where people travel frequently, because perceived travel time in the direction of the destination will fall.

is constant. They are, however, more complex because perceived as well as actual travel time are important. Qualitative aspects of a path will affect perceived the perceived length of trip. The quality of a pedestrian's experience in a street grid must therefore be understood in order to evaluate the effective drawing distance of an amenity within that grid.

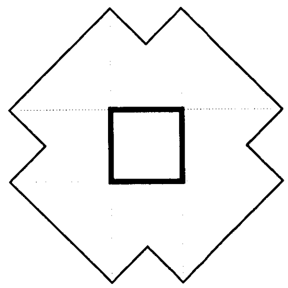
If complex or indirect travel paths increase perceived travel time, pedestrian travel contours will distort to favor properties near direct lines of travel. Frequent street intersections along a path, or high traffic along the roads, may also increase perceived travel difficulty or time. Having several ways to reach a park may increase perceived ease of travel, and extend the drawing radius of the amenity.

Alexander (1977) and others have noted that familiarity with a path reduces its perceived length. Amenities near a dominant center or travel destination may have travel contours that extend asymmetrically away from the dominant center. Residents living between the amenity and the primary destination will be less familiar with that amenity, and therefore value it less, then residents who must pass it as part of daily travel. (Illus. 2.9)

This effect is particularly true for institutions, like stores, for which visibility is a more important indicator than travel distance. For stores, location on a heavily travelled road will be valuable relative to one on an adjacent side street, even though the mean travel distance from surrounding properties is similar. In part, this is because retail stores rely on



Illus. 2.10
Transportation cost contour around a linear amenity. If access to the amenity occurs only at endpoints, the gradient will resemble two, overlaid point gradients, as in the model on the left. If access occurs at any point along the line, the gradient will resemble the model on the right. This distinction between point access and continuous access is critical for all models.



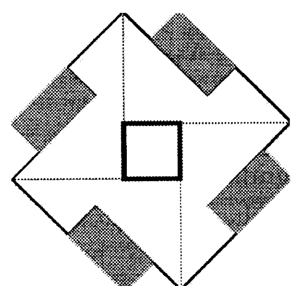
Illus. 2.11
Transportation cost contour around amenity. In this model, the park occupies one square in a gridiron, and roads lead perpendicularly away from each corner in both directions.

impulse travel, while neighborhood parks are often destinations. That impulse, however, depends in part on familiarity, and locations along well-traveled roads will have high perceived visibility relative to physical travel distance.

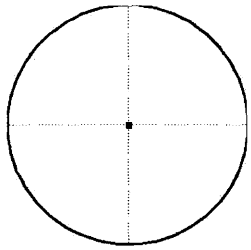
The travel cost contour of linear amenities will reflect a simple distortion of the point model if access is possible at all points along the line. (Illus. 2.10) If access points are few, each place of access will exhibit a simple point gradient effect with overlapping contours. A section of boulevard that runs between two perpendicular streets is one example of a park that would produce Illus. 2.10. If residents have a preference for multiple paths of access to an amenity, the porosity of the street grid, and the corresponding number of different paths, may exhibit additive properties.

An amenity with area, like a park, will have travel cost contours that are conceptually similar to those of a linear amenity. (Illus. 2.11) The shape of the contour will change, however, with respect to distance. At very close distances, as in Illus. 2.11, the contour will reflect the outer edge of point amenity gradients placed at each corner of the park. At very large distances, the contour will assume a diamond form, similar to that of a point amenity.

One critical difference between the rent gradient around a park and one around a point amenity is the opportunity cost of the land the park sits on. Land devoted to park space is land not developed with housing, after all. The



Illus. 2.12
Transportation cost contour around an amenity with a pinwheel street grid. In this model, residential blocks extend past each corner of the park, so that only one street intersects the edge of the park at each corner. Unless blocks are punctuated by pedestrian paths, total gradient value declines sharply.The shaded area represents proximity value lost relative to what a gridiron plan would produce.

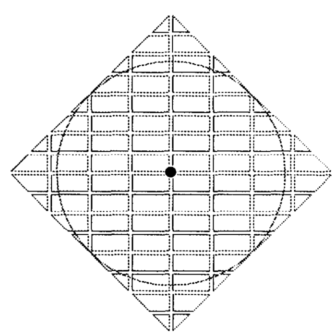


Illus. 2.13
Diagram of a radial cost contour. This may be an appropriate model for location-specific disamenities, like noise or air pollution, where radial distance corresponds to the actal disamenity effect.

total proximity premiums generated by the park must offset not just the cost of constructing and maintaining the park, but the profit on houses that could have been constructed had the park not been built.

Amenities with irregular street grids have more complex gradient characteristics than gridiron parks. A park bordered by a pinwheel street grid will have net proximity gradients that are sharply lower than those of a gridiron park, because the pinwheel plan reduces the amount of land within walking distance of the park relative to a gridiron. (Illus. 2.12) The effect is difficult to calculate as a generality, because the arrangement of residential blocks outside the immediate vicinity of the park is not implicit in the pinwheel as it is in the gridiron. However, the impact of the street arrangement will resemble Illus. 2.12 at short distances, coming to approximate a diamond at the periphery. Properties in the immediate vicinity place the highest value on the park, however, and so the impact of the street grid on the total proximity premium created by the park is substantial.

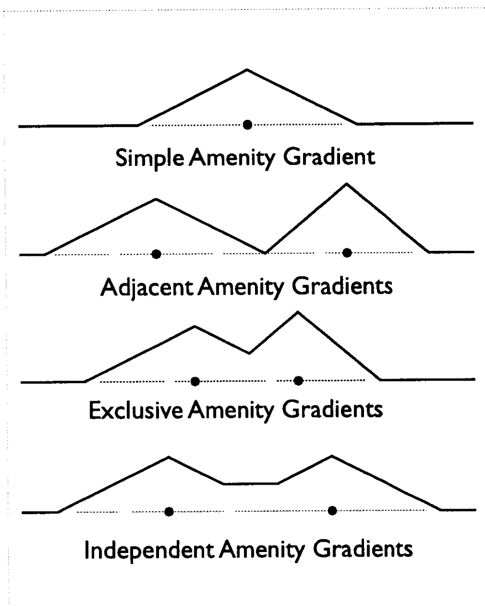
Locations may also exhibit disamenity effects on adjacent properties, whether due to traffic, noise, pollution, or fear of crime. For some variables, like traffic or fear of crime, travel distance may be an effective proxy for their effects. The impact of other factors, however, particularly environmental ones, depends on actual physical distance. (Illus. 2.13) If a facility, like a large regional park, produces both highly localized disamenity effects - from traffic and noise - and



Illus. 2.14
Diagram illustrating coverage difference between transportation cost contours (outside edge of blocks) and radial contours (circle) around an intersection. In this example, 57% more land is within the region of influence of the radius model than the transportation cost contour model.

more broad amenity effects due to the park facilities, the net value of the park to any property will comprise the sum of the travel distance-based amenity effect and the radial disamenity effect.

Many conventional neighborhood models use radial distance as a proxy for travel distance. Perry's neighborhood unit diagram for the New York Regional Plan, for example, overlays a circle with a 1300-foot radius on the diagram to indicate maximum feasible walking distance to the center. For spatial amenities with very widely dispersed benefits, like proximity to a central business district, major shopping center or airport, the metropolitan level, where fragmentation of the street grid at many points minimizes the relative efficiency of travel in any particular direction, the radius might be an appropriate proxy for travel distance. It will underestimate the effective distance to other locations, but may not be biased systematically in the direction of particular streets or arterials.

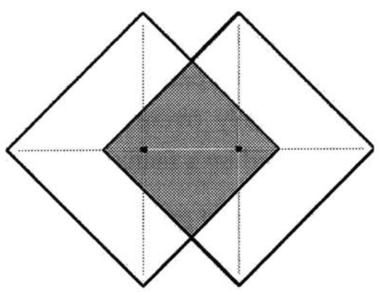


Illus. 2.15
Section diagrams showing stylized proximity premiums aound location amenities. The diagrams show rent effects that vary as a linear function of distance, though many will actually be non-linear with respect to distance.

The use of radial measurements to approximate travel distance at the neighborhood scale, however, will produce misleading estimates of the drawing radius of facilities with localized effects. Radial measurements of proximity will overestimate the value of a park to homes along indirect paths to that amenity, and will generally overestimate the area of land served by a facility. (Illus. 2.14)

Proximity gradients associated with amenities may also overlap, as when a house is within walking distance of two separate parks. The net proximity-based premium that such a house would receive will depend both on the value of proximity to each individual amenity and on how those proximity premiums interact. (Illus. 2.15) Proximity gradients may, for example, be mutually exclusive: in that case, only the proximity value of the closest amenity would be reflected in a property's value. Neighborhood playgrounds, for example, may be partly exclusive. The value to a property of a second nearby playground, similarly attractive and with similar equipment to the first, is, while not incidental, minor compared to the value of the first. Travel distance to the closest playground is therefore the critical variable in this case. (Illus. 2.16)

Proximity gradients may also be independent, or neutral with respect to one another. Proximity to a park and to a corner store might qualify as independent gradients. Both are desirable, and the presence of one proximity gradient does not diminish the value of the second for an individual property.



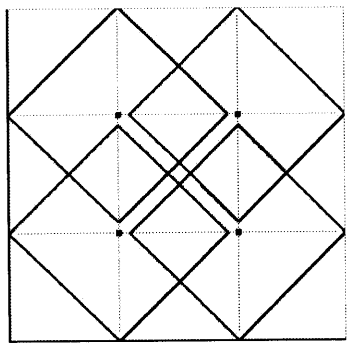
Illus. 2.16

Transportation cost contours of adjacent, exclusive amenities. The shaded region represents land with foregone rent premiums. The contour connects points of equivalent cost, but does not address characteristics of the gradient inside the contour. The value represented by the shaded region in this diagram will depend therefore on the magnitude of the gradients as well as on the area of the shaded region. As the distance between the amenities falls, for example, the value of foregone gradient value will rise faster than the area of overlapping gradients.

Properties within the range of multiple proximity gradients will exhibit more complex characteristics and will appeal to residents with more complex preferences and needs. If the effect of each amenity is comparable, and if the amenities are not exclusive, those properties will derive a higher percentage of their value from location attributes than a comparable property influenced by only one gradient.

The degree to which the parks in a multiple-park neighborhood concentrate at the center of that neighborhood will depend in part on whether the associated land proximity premiums are largely independent or exclusive. A group of parks with independent rent gradients, for example, can be located closer together without sacrificing potential proximity benefits. (Illus. 2.17) If the proximity benefits of the amenities are exclusive, however, there will be no distinction to a profit-maximizing developer between premiums lost to adjacent landowners and those lost to overlapping gradients. The location of each amenity will not be biased toward either other amenities or to the edge of the parcel. (Illus. 2.18)

One effect of this incentive to contain proximity-based rent gradients within a neighborhood, at least in an environment of fragmented land ownership, is to create a series of small, monocentric

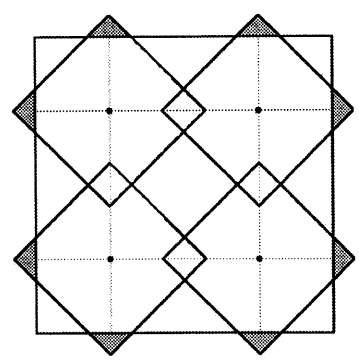


Illus. 2.17
One possible spacing of point amenities in a 160-acre quarter section. In this diagram, individual proximity gradients are independent - that is, a second amenity within travel distance is just as valuable to a homeowner as the first amenity.

neighborhood plans. Each neighborhood in such a system will have a central core of amenities surrounded by highly desirable lots. This in turn will be circled by progressively less desirable lots out to the edge of the parcel. Necessary facilities that produce disamenities will be located along arterials at the edge of the neighborhoods, thereby transferring part of the disamenity effect to neighboring landowners. This description resembles conventional suburban development patterns because those patterns are the product of rational landowners pursuing their individual self-interests in an environment of fragmented land ownership.

Assessing the net impact of a new park on property values is simple if ownership of the surrounding land is undivided. The value of the park to the developer is simply the sum of the proximity premiums for each lot in the development parcel net of construction, maintenance and opportunity costs. A typical development, however, is too small to capture the entire rent gradient associated with the park, and is bordered by properties under separate ownership. The feasibility of building a park within any individual development, then, depends on whether enough of the proximity benefits of the park accrue to lots within that development to recoup the costs - short and long term - of the park.

One implication of gradient models in an environment of limited parcel size is that developers who provide location amenities will locate them in the approximate center of the development parcel,



Illus. 2.18
One possible spacing of identical point amenities in a 160-acre quarter section. In this diagram, individual proximity gradients are exclusive - that is, having a second amenity within travel distance provides no additional value to a homeowner.

so as to capture as much of the associated proximity premiums as possible. This will not be the geographical center of the parcel, but the center that averages the transportation costs to the periphery of the site. Travel costs, rather than radial distance, are the appropriate method for locating the center. This distinction, while irrelevant in a gridiron, could have significant effects on a topographically irregular site.

Developers who control very large parcels of land are better able to capture the positive rent gradients associated with proximity to amenities like parks, and will therefore be more likely to include those parks in new neighborhoods. One benefit of the neighborhood unit of development, which is often treated as encompassing an area of 160 acres or a quarter section, is that it allows some flexibility in locating a park within the neighborhood while still capturing the associated proximity premiums. Large neighborhoods, like those based on a quarter section, may also support multiple parks, spaced evenly throughout the neighborhood to maximize proximity premiums. This strategy is feasible because, while the maximum drawing radius of a neighborhood park may be the distance of a five minute walk, or approximately 1300 feet, a majority of the proximity benefits associated with that park occur in its immediate vicinity. Even if park proximity gradients are exclusive, those gradients can overlap at their edges without substantially diminishing the net value of each park's proximity benefits.

Very large development parcels may also require facilities whose effects on surrounding land rents are primarily negative. Developers will tend to locate these facilities at the perimeter of the parcel, to minimize their effect on properties in the development. Many other facilities, however, even those with spatial benefits, produce disamenity effects in their immediate vicinity. Senior high schools or busy shopping centers are such facilities, as are freeway on-ramps or large regional ball fields. An individual developer, holding a limited parcel, may not be able to provide these facilities economically. Only if the development parcel is large enough to encompass not just the radius of the disamenity effect but that of the amenity effect as well, and if there is a resulting net increase in property values associated with the amenity that can be captured by the developer of that amenity, will these facilities be provided willingly. Land uses with complicated or large proximity effects, then, will favor larger development parcels.

The common theme is that the developer of a parcel of limited size has the incentive to exclude activities or uses that produce disamenity effects whenever possible, or to move those uses to the perimeter of the site. Uses that only have positive amenity effects, in contrast, will be clustered near the center of the neighborhood, or distributed throughout the neighborhood but with a bias toward the center. Otherwise, land rent premiums associated with the park, which are necessary in part to justify the economic costs of the park, will accrue to adjacent, non-contributing landowners.

The localized nature of park amenity gradients affects the optimal distribution of parks within a neighborhood when that neighborhood must built out in phases. The neighborhood will be more viable financially when the phasing of park construction costs corresponds to the revenue stream associated with park premiums. One challenge of providing amenities that are paid for by premiums on adjacent lots is that the cost of the amenity must be paid at the outset, while the expected revenue stream arrives only later, at the time subdivided parcels and their accompanying homes are sold. The costs of the park must then be carried by the developer until all the lots that receive benefits from that park have been sold. When the neighborhood is large relative to the surrounding market's potential to absorb new product, and phasing therefore occurs over an extended time period, the cost of constructing a park at the outset is substantial, and the risk horizon of that investment is long.

These costs create powerful incentives for developers to reduce the time between construction of the park and time of sale for adjacent properties, and in turn helps to determine the optimal design of the community. A park will be most viable if the surrounding market can absorb the entire stock of housing around that park at once. In part for this reason, small parks are more likely to be viable in most markets. Expenses associated with constructing the park and the receipt of premiums derived from the sale of lots around that park will occur close together.

A developer must construct the park at the outset, since its effect on home sale prices depends significantly on homeowners seeing the park, completed, at the time of purchase. For this reason, large, centralized parks become especially difficult when development phasing is required. One option is for the developer to develop only one part of the surrounding neighborhood in the initial phase. However, the developer then receives only a fraction of the total expected proximity premiums needed to justify the park at the outset, and must carry much of the cost of constructing the park until the completion of subsequent phases. Alternately, the developer can build the houses immediately around the park in the first phase. Because the adjacent lots receive the largest premium from the park's proximity, this strategy would better match the expense of the park with the associated revenues. However, this approach assumes that the market, while it cannot absorb all the parcels in the development in a single phase, can absorb all the park-front lots in a single phase. A more likely outcome is that the first phase would overbuild the market for those lots, reducing the bargaining power of the developer in negotiations with homebuyers and driving down the price of those lots. In addition, the construction of a neighborhood in sequential rings offers no obvious strategy for staging, because resiidents of the initial phase will have to travel through the construction of all subsequent phases.

A neighborhood with several small parks, in contrast, can be built in phases easily. Each small park is bordered by fewer homes than a large park, and can therefore be absorbed by a market more quickly. This allows the construction of park space and of the accompanying homes that most benefit from the park space to move roughly in tandem.

The viability of a neighborhood park depends not just on the total premiums net of cost, but on the timing of the receipt of premiums with respect to that of the costs. Large parks may create value, but whether that value can be captured in a way that makes the park economically feasible depends on both the size of the parcel and the absorption capacity of the market.

Implications

Analyses of travel distances suggest first that conventional location models, which use radial distance as a proxy for accessibility, are inaccurate at small scales, where the relative difference between radial distance and travel distance can be great. Theoretical models of travel time provide a more constructive way of thinking about the value of location. The methodology is simpler than those used in conventional traffic studies, because neither travel speed nor congestion are significant factors. However, pedestrians have complex path preferences that must be considered in developing models.

The radial plan provides, in theory, the greatest amount of access to a central point. The difficulty of wayfinding, the disturbing monotony of perpetually curving streets, and the awkward lot shapes such a plan produces make it impractical for development.

Gridiron plans provide consistent access to a central point, but incorporate a bias against properties located on the diagonal of the direction of roads approaching the park. A preference by pedestrians for direct routes exacerbates this bias. Diagonal boulevards leading to the amenity correct this bias, but create many awkward lot shapes and expensive intersections. In addition, the basic gridiron plan requires an open network to be effective. Otherwise, traffic concentrates on particular roads and necessitates a functional hierarchy of road treatments. As a result, a gridiron plan with diagonal boulevards cannot easily omit other roads in compensation, and so raises the total cost of infrastructure.

Other researchers have proposed theoretical models addressing various aspects of proximity. Actual site and market conditions, however, will be too complex to accommodate these proofs. The value of diagrams, then, is as tools to evaluate possible effects of planning decisions on neighborhood quality. Several conclusions can be derived from this kind of analysis, though these conclusions are inherently conditional to specific site conditions.

First, the proximity of the houses in any neighborhood to any particular point in it can be diagrammed, and the contour lines that result will follow directly from the form of the street grid. Amenities favor street grids that produce gradients approximating what a simple radial distance measurement would produce.

Second, an anslysis of rent gradients favors particular patterns of park and residential development. Development phasing, common to most new neighborhoods, favors fragmented parks over consolidated ones. Fragmented parks better match the expenditures associated with the park to the revenue stream that derives from those costs.

Third, amenities, when planned properly, are placed and programmed according to the preferences of individual consumers. The range of preferences inherent in a rent gradient around a park implicitly support neighborhood heterogeneity. Extended to a neighborhood with multiple amenities that meet different needs, gradient-based models support a rich mixture of demographic and economic groups, quite unlike conventional, homogenous suburbs.

Fourth, an amenity produces only a potential gradient. The extent of the realized gradient depends on a series of planning decisions and on proper market analysis. Major arterials can diminish the value of proximity for pedestrians, and many non-residential uses receive no value from recreational amenities. The presence of similar facilities nearby, too, can prevent the realization of some or all of this gradient.

The research assumes that the facilities a park has are of interest and value to nearby residents. Household types have different preferences, and so the design of the park will influence the household types that choose to live nearby. Household preference should correlate with preferences for other aspects of housing and location. These must be complementary in order for the development to ralize the full potential gradient of a park.

3

Preface

The third section of the paper presents the structure and results of the statistical research project. For the convenience of readers, the section is written to be largely freestanding. It includes a separate abstract, introduction, and series of appendices. The bibliography remains in consolidated form at the end of the overall work due to the difficulty of discriminating among different sources as influences. One underlying argument of the text, after all, is that neighborhood planning and housing economics are closely interrelated and should be addressed jointly.

The data set is tested with several levels of hypothesis of varying degrees of specificity. The most general hypothesis, and the starting point of the thesis itself, is that properties are more valuable to residents when near parks. The magnitude and behavior of this value determines the economic viability of parks. The research tests a series of secondary hypotheses as well. :

- Accessibility rather than proximity determines park value to adjacent properties.
- The accessibility of a neighborhood park to pedestrians is more important than vehicular accessibility. A park's area of influence will therefore reflect the walking range of pedestri ans rather than driving range.
- Homes that face onto parks across streets are more valuable than those that abut parks on the back or sides of the lot.
- Parks that are not just accessible but also highly visible to residents have the most value to surrounding parcels. Parks accessed by simple, clear paths will be more visible, and hence more valuable, than parks reached by complex, indirect paths.

- Large parks are more valuable than small parks, but the impact of added size is small relative to the benefit arising from the park's presence.

The thesis also introduces a series of tertiary hypotheses, based on focused comparisons of different segments of the data set.

- Small parcels value proximity to the park more than large parcels.
- Small parcels place a higher value on lot area (as a percent of total sale price) than large parcels.
- The marginal value of additional lot area is significantly higher for small parcels than large.
- The marginal value of additional park area is also significantly higher for small parcels than large ones.
- Homes that are more expensive than average for their area will sell at a discount relative to what their physical characteristics would predict. Homes that are less expensive than average will sell, correspondingly, for a premium.
- All else equal, lot depth is preferable to width for most lot sizes. Residents value a usable private space behind the house more than street frontage.

Implicit in the model are assumptions about neighborhood form and the value of location. Many of these are not directly relevant to the principal thesis topic, but are important both to refine the model's predictive power with respect to the primary topics and because they carry implications about optimized neighborhood design.

- Proximity to major metropolitan centers - in this case, central business districts and the Dallas/Fort Worth airport - is desirable. At very close distances, however, a disamenity effect may reduce property values.
- Other local amenities besides parks will affect location value. Schools, churches, retail areas and freeways, for example, should all exhibit some combination of amenity and disamenity effects.

Like any model, this one does not purport to represent reality comprehensively. Variables that would undoubtedly affect property value are not included, either because they were not available or because available data was compromised or unreliable. Other studies in the literature, for example, are more comprehensive in their treatment of the physical attributes of the housing stock. An assumption of the model then is that while these variables if available and included would be significant, that there is no obvious reason to assume those attributes would be distributed non-randomly among properties in the sample set with respect to the critical variables in the model. The absence of those variables should not therefore affect the overall validity of the conclusions, even though they affect the total predictive power of the model.

Even if particular attributes of the housing stock are non-randomly distributed in the population, they may be captured in part by other specifications. Because not all potentially relevant attributes are measured, these variables will function in part as proxies for non-measured attributes. House age, for example, will correlate with a host of physical attributes that cannot otherwise be measured. Distance to the central business district, too, may reflect the age of the neighborhood and therefore the attributes associated with it as much as commuting costs. This is regrettable, but as the behavior of likely proxies is not critical for the research questions it is acceptable.

Transferability

We are in great haste to construct a magnetic telegraph from Maine to Texas; but Maine and Texas, it may be, have nothing important to communicate.

- Henry David Thoreau

Regression analysis cannot extrapolate beyond the range contained within the data set. This constrains the applicability of site-specific research to other locations, and it prevents some kinds of formal extrapolations, too.

The relative value of parks in different regions should depend in part on climate - that is, on the kind of functional benefits provided during different seasons. One might assume that parks in Montana, which have a shorter season for use, would be less valuable than parks in Miami or in Los Angeles. All else equal, the greater the climatic similarity between two places, the more likely research performed in one is to be applicable in the other. Part of the value of Dallas/Fort Worth as a study site, then, is that it resembles climatically many of the high growth regions of the country. Conclusions derived from the study of Dallas/ Fort Worth will apply to other sites more readily than would a study in, say, Kennebunkport.

The degree to which the physical infrastructure of the city supports pedestrian travel versus other modes will affect the willingness of residents to walk to neighborhood parks, and the availability to those residents of substitutes. Most suburban areas will resemble Dallas/Fort Worth in the dependence of their residents on automobiles and in the scarcity of sidewalks or paths that would enable safe pedestrian travel. Results from the research should be broadly generalizable to other suburban areas in this respect. Residents of dense urban areas, in contrast, may have a different set of expectations. The combined effect of fewer cars per household, better transit, and an expectation that facilities will be nearby means that suburban proximity gradients cannot be transferred directly to sharply different densities.

The study concerns single-family houses, and addresses neighborhoods composed principally of such houses. Lot sizes are suburban in character, and uses are seldom mixed. Contemporary neighborhood planning, however, is concerned principally with mixed housing types, high densities, and diverse uses. The thesis derives rules, inherent in existing patterns of suburban development, that can be applied to other, more valuable and sustainable neighborhood patterns. However, the limited range of diversity in the model means that these rules must be defined carefully, and the inherent limits of the model acknowledged. Extrapolation must therefore be done cautiously, with the understanding that it rests on a theoretical rather than statistical basis.

Executive Summary

The study explores the effect of neighborhood parks on residential property values. Using data from the Dallas/Fort Worth metropolitan area, regression analyses are used to infer a rent premium gradient within walking distance of parks. The results are very significant with respect to the investigated variables. Some excerpts follow:

The study finds that homes adjacent to parks receive an approximate price premium of 22% relative to properties 2600 feet away. Approximately 75% of the value associated with parks occurs within 600 feet of travel distance. Indirect paths are found to detract from proximity value. Both because of the limit of the gradient and because of the bias against detours, the porosity of the street and sidewalk plan in the park's vicinity is of great importance in maximizing that park's value to the surrounding residents.

Large parks are more valuable to residents than small parks, but the premium is small relative to that of proximity. All else equal, then, more value will be created by a series of small parks, which permit more total houses in their vicinity, than by a single, large park.

Parks bordered by roads are substantially more valuable to the surrounding neighborhood than parks bordered by private lots. Parks bordered by a subcollector are more valued still. Maximizing the value of parks requires that they be very visible to the surrounding community and easily accessible.

Small lots place a higher value on proximity to the park than do large lots, perhaps because lot area acts as a substitute for public open space. All else equal, the small lots in a development should cluster around the park.

Small lots also value park acreage more, as a percent of sales price, than do large homes. If a range of park sizes exist in a neighborhood, the least expensive homes should border the edge of the largest park.

Homeowners prefer lot depth to lot width, holding lot area constant. Small lots value depth most, all else equal, because the impact of marginal depth on the back yard's usability is highest. Narrower, deeper lots should be used both to maximize the value of land and to minimize cost of infrastructure.

Abstract

The study explores the effect of neighborhood parks on residential property values. Using data from the Dallas metropolitan area, regression analyses are used to infer a rent gradient within walking distance of parks. The study supports previous research on the impact of parks on property value, finding that homes adjacent to parks receive an approximate price premium of 22% relative to properties 1/2 mile away. Park size is found to influence this effect positively. In addition, a complex, indirect path from the house to the park is found to diminish the value of proximity to the park. The research has implications for the design of residential neighborhoods and the viability of privately financed parks in those neighborhoods.

Introduction

Many studies have attempted to measure the impact of parks on property values, but few have done so from the point of view of a developer or designer. Parks are a costly and risky amenity, whose effect on the market value of surrounding homes is often uncertain. In providing parks in new developments, then, the developer or designer has two tasks. The first is to estimate, before construction, what premium residents will pay to be near the amenity. The reliability of this estimate is crucial to the project's success, because it affects the availability and cost of financing and the amount of risk to participants. The second is to use the additional revenue created by park proximity premiums to offset the cost of the park. These costs can include both the construction and maintenance cost of the park itself, as well as the opportunity cost of foregone development on the parkland. The surplus of proximity premiums above total park cost, and the benefits of the park to overall development sales velocity, represent the profit opportunity that justifies the park's inclusion.

Neighborhood design is too complex for a single, optimized economic solution. Research may however inform the basic strategies used by designers, and thereby improve understanding of the trade-offs associated with different design approaches. In doing so, the interaction of plan efficiency, construction cost, expected revenue and sales velocity together can form the basis of a design methodology for new residential neighborhoods.

Proximity

The five-minute walk as boundary is a staple of design literature. When more than a five-minute walk is required to reach an amenity, it no longer feels accessible and use declines. Parks are an obvious destination for pedestrians, and add much of their value through use. If these assumptions are correct, we should expect to see the value of parks decline to insignificance at a travel distance of 1300 feet, the approximate length of a five-minute walk. Numerous models (Kelbaugh (1989), Adams (1929)) use such an assumption as the basis for neighborhood planning. Some authors have proposed even more stringent standards for walkability. Alexander (1977) found that park use declined dramatically for residents living more than three minutes away (800 feet). Based on this, he argued that parks be placed at 1500-foot intervals instead of the 2600-foot spacing implied by a five-minute travel time. Alexander's concern was with providing accessibility to all residents rather than necessarily to determining the spacing that optimized total neighborhood value.

Citing previous research, Alexander further argued that residents are naturally more familiar with the area between where they live and their most frequent destinations outside the neighborhood. This familiarity reduces the perceived travel time to that destination relative to actual physical distance. The effect is to extend an amenity's zone of influence, or "catch basin," in the direction away from the general direction of travel to the park. A portion of the value of park visibility will depend then on traffic patterns in the surrounding neighborhood.

Park Size and Type

Nolen (1913) surveyed early attempts (from 1850 to 1912) to evaluate the impacts of parks on municipal tax rolls. He quoted estimates that land abutting Kansas City Boulevards sold at a 31% premium, and the entire district surrounding Cambridge Field, Cambridge, received an average 16.5% premium. Moorhouse and Smith (1993), studying townhouses in 19th century Boston, found that frontage on a Federal style park brought a 59% premium, while Victorian parks generated 11.5% premiums. Waddell, Berry and Hoch (1993) determined that every percent of land devoted to parks within a census tract boosted home values by 0.1%. Hammer (1971) found that the value of land itself within 100 feet of a park was worth 51% more than average, while noting that the value was probably considerably higher for properties abutting the park. Correll, Lillydahl and Singell (1978) observed a 25% premium for houses adjacent to a well-planned greenbelt in Boulder relative to those 1300 feet away. They also noted that an arterial placed between homes and the park appeared to reverse the gradient, and that rent effects were higher when the neighborhood had been designed around the park to maximize its accessibility. Weicher and Zerbst (1973) found a 23% premium for houses facing a park relative to similar houses elsewhere.

Lyon(1972) and Hammer, Horn and Coughlin (1971) observed that properties directly abutting parks (without an intervening street) were either no more valuable or less valuable than houses further away, a finding supported by Weicher and Zerbst (1973). Lack of privacy is the commonly attributed cause, and accords with visual surveys of Dallas neighborhoods. Given the choice between the view of a park and the privacy of a fenced back yard, abutting homeowners almost invariably choose the latter.

Some recent work has calculated the value of marginal increments of park acreage to neighborhood value. Netusil and Lutzenhiser (2000) found in a study of Portland that different park types had different optimal sizes and rent effects. "Natural area parks," in which a majority of the park was retained in a semi-wild state, created the largest rent gradient - an average 18% premium within 200 feet of the park - but had an inferred optimal size of 258 acres. Rent effects for "urban parks" were less significant and robust, perhaps in part because urban parks have traditionally included greater variations in quality.

Many planning studies, particularly those of the progressive era, address the perceived functional requirements of parks and the impact of those requirements on size, but do not assess market pricing of those attributes. Hanmer (1928) proposed 25 square feet per child between the ages of 5 and 14 within walking distance. Based on this assumption, a conventional suburban quarter section with a density of 4 households per acre, household size of 2.67 and with approximately 20% of the population under age 14 would have approximately 1/5 of an acre of playground space. This figure seems low even at first glance, reflecting in part lower current density standards and household size. Hubbard's marginally more generous standards (1922) would provide 0.4 acres for the same community.

Hanmer proposed 50 s.f. of recreation space for every person between the ages of 12 and 24 in the city. If people of that age range comprise 35% of the population, and assuming the same level of density previously discussed, this provides only 2.8 acres of athletic space per square mile of land. Hubbard's standard provides only four fifths of an acre. These figures reflect an era in which physical recreation was not yet the pastime it is now, as well as revealing the biases of the functionalist arguments used. One basketball court requires 4,700 s.f., one tenth of an acre. Two tennis courts require approximately one fifth of an acre of land. A single soccer field, excluding sideline areas, has an area of 1-¾ acres.

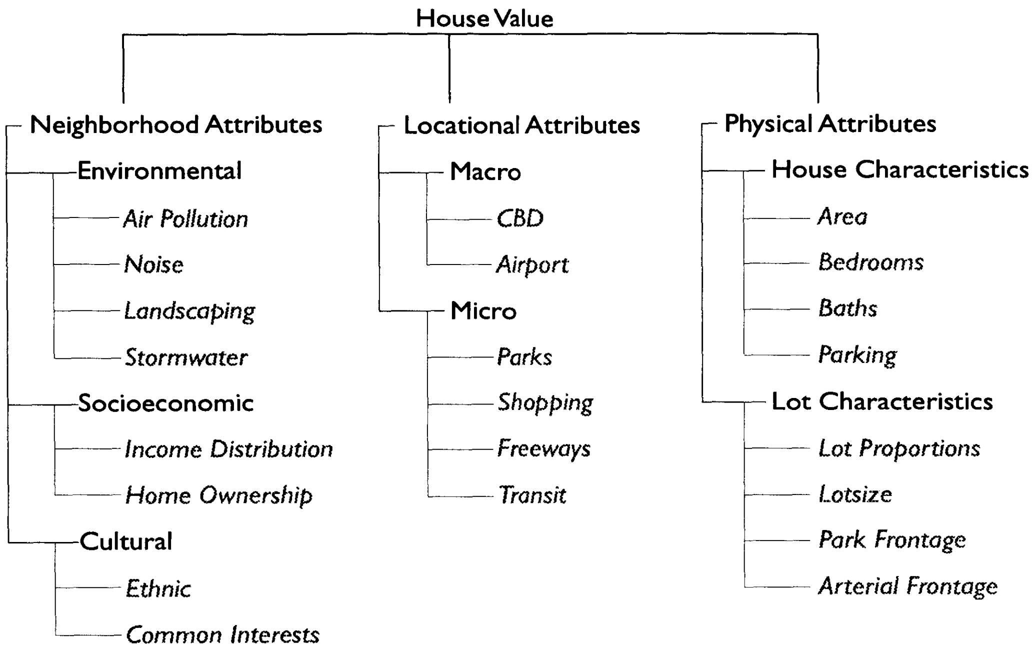
Alexander (1977) in contrast, suggested that the potential to feel physically separated from the neighborhood a sense of physical separation from the neighborhood for occupants was the functional characteristic of an effective neighborhood park. He placed the lower boundary of a park's size at 60,000 s.f., or 1.4 acres. If all houses in a neighborhood were within a three-minute walk, a quarter section would include 12 park acres, or 7.5% of the land. Even this, however, is low compared to Adams (1934) who recommended that 20% of the land in a residential subdivision be reserved for parks.

Unlike the models of Alexander and Adams, functionalist standards break down at low population densities because certain space requirements for athletics are independent of population. Functionalist standards, however, were linear functions of density, a method of assessment that encouraged development at low densities by reducing the requirements for park space disproportionately. This bias in favor of low residential densities was characteristic of the period. Writing in 1929, Harold Buttenheim, editor of the journal *The American City*, warned of "increasingly intolerable congestion of in skyscraper and apartment house" and pined instead for "the ideals of the Spacious City." Similar examples are legion. When park infrastructure costs are fixed with respect to population, however, and a maximum drawing radius for the park is assumed, economy suggests that populations should cluster around those parks to minimize per-unit costs. This cost structure implies that optimal density in a neighborhood with substantial amenities will be higher than what conventional suburban standards encourage or permit.

Valuation

Factors comprising house value can be placed within a framework for clarity. [1] (Illus. 3.1) An initial division is between the attributes of the housing itself and those related to its location. Location variables are divided into macro- and micro-location components. Macro-location variables here are those for which precise locations are not needed to cal-

[1] This follows the lead of Berry and Bednarz (1979)



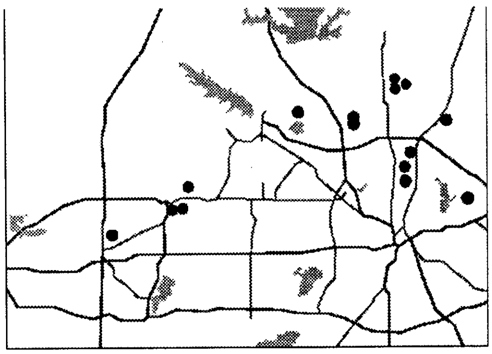
Illus. 3.1
Components of housing value. Items in italic are non-comprehensive examples of the category.

culate their impact on house value. The distance to a major airport, for example, can be understood well at the level of census tract or neighborhood; variation in travel times among different houses within the neighborhood are insignificant.

Micro-location variables, in contrast, require a precise location within a street grid for valuation. The travel distance from a house to an elementary school, for example, will fall in this category, as would neighborhood parks.

Housing characteristics are divided into those that describe the physical characteristics of the unit itself, its lot, and the character of the neighborhood containing the unit.

The physical characteristics may include both absolute and relative measures. An absolute measure would be the area of a house or the number of covered parking spaces it has. A relative measurement would assess variables in relation to others in the neighborhood. The effect of a home's age on its value



Illus. 3.2
Dallas / Fort Worth metropolitan area map, showing study parks.

may for example depend on the age of surrounding properties.

The neighborhood characteristics include socioeconomic, environmental and cultural factors. Environmental variables include, among others, air pollution, landscaping and stormwater runoff. Cultural variables will include racial and ethnic distributions that might affect property value, while socioeconomic variables will address the level of resources available to the community and its members.

Not all of these variables were included in the final model, though many were tested at early stages. Others were included for their explanatory power in the model, and not necessarily because they directly addressed the principal research questions. The framework does however make the focus of the model visible, and suggests future areas of research and refinement.

The Model

A series of study parks in the Dallas/Fort Worth metropolitan area were selected to test the potential of land rent and property characteristics as a design tool. (Illus. 3.2) This analysis focused on the neighborhood scale, and excluded from the study parks that had characteristics with unique features, such as swimming pools or major ball fields, that might attract visitors from outside the neighborhood. This eliminated disamenity effects observed around major parks as a concern (Weicher and Zerbst). Whenever possible, parks near major arterial or collector streets, shopping or commercial centers, or abrupt changes in demographic characteristics were excluded from the study to clarify the effect of the park. As much as possible, the data set encompasses a series of homogenous residential areas around centrally located parks.

The data set initially comprised approximately 3200 residential sales transactions recorded from January 1998 to May 2000 in MLS databases. (See Appendix D for a note on property valuation for tax purposes in Dallas.) Data coding was by MAPSCO grid, a standard organizing format for the region, and the geographical area of analysis was based on transactions in the adjacent grid squares. Distance measurements were calculated

Illus. 3.3
Set of independent variables

sale.................... Period of sale by quarter, from present
sf......................... House square footage
sf_2.................... House square footage, squared
sf_avg................Average house square footage in neighborhood
sf_dev................Difference between actual and average square footage
age......................Age of house, in years
age_d................ (1/age) of house, in years
lot.......................Size of lot, square feet
lot_dif...............Difference between lot width and lot depth
ratio....................Ratio of lot width to lot depth
bed.................... No. of bedrooms
bath...................No. of baths
fp.........................No. of fireplaces
cvp.....................No. of covered parking spaces
d_pool..............Dummy variable, '1' if house has pool
d_story.............Dummy variable, '1' if house has two stories
dist......................Travel distance to park, in feet
dist_1................ $1/x^{1/10}$, where 'x' is travel distance to park
detour.............. Difference between radial and travel distance to park
park_1................Park size, in acres
per_road..........Percent of park perimeter bordered by minor roads
per_sub............Percent of park perimeter bordered by subcollector roads
j_dist.................Distance to junior high school, in feet
j_score............. 1999 average pass rates in junior high school
free_1...............Travel distance to freeway on-ramp, in feet
free_0...............Travel distance to freeway on-ramp, in square root of feet
free_2...............Travel distance to freeway on-ramp, in feet squared
rad_air..............Radial distance to Dallas/Fort Worth Airport, in miles
rad_cbd..............Radial distance to closest CBD, in miles

Illus. 3.4
Regression output

			Number of observations	1768.0
			F (29, 1738)	244.27
SS	**df**	**MS**	**Prob > F**	0.0000
284.84	29	9.8220	**R-squared**	0.8030
69.88	1738	0.0402	**Adj. R-squared**	0.7997
354.72	1767	0.2007	**Root MSE**	0.20052

	Coefficient	**Std. Error**	**T Stat**	**P > abs(t)**	**95% Interval**	
sale	(.0191991)	.0018282	(10.502)	0.000	(.0227848)	(.0156134)
sf	.0010081	.0000738	13.656	0.000	.0008633	.0011529
sf_2	(9.56e-08)	1.03e-08	(9.306)	0.000	(1.16e-07	(7.55e-08)
sf_avg	(.0001595)	.000028	(5.696)	0.000	(.0002144)	(.0001046)
sf_dev	(.002805)	.0005571	(5.035)	0.000	(.0038977)	(.0017123)
age	.010258	.0005784	17.736	0.000	.0091236	.0113924
age_d	.6484157	.0776752	8.348	0.000	.49460689	.8007624
lot	.0000251	3.15e-06	7.953	0.000	.0000189	.0000312
lot_dif	(.0022015)	.0003346	(6.580)	0.000	(.0028578)	(.0015453)
ratio	.0009079	.0001975	4.597	0.000	.0005206	.0012953
bed	(.0515784)	.0100127	(5.151)	0.000	(.0712166)	(.0319402)
bath	.0389183	.0110803	3.512	0.000	.0171861	.0606505
fp	.0596687	.0103175	5.783	0.000	.0394327	.0799047
cvp	.0307607	.0104754	2.936	0.003	.0102149	.0513064
d_pool	.0338799	.0122501	2.766	0.006	.0098534	.0579065
d_story	.0173316	.0141813	1.222	0.222	(.0104826)	.0451459
dist	.000033	3.95e-06	8.342	0.000	.0000252	.0000407
dist_l	1.614474	.2709166	5.959	0.000	1.083117	2.145831
detour	(.0000153)	5.43e-06	(2.806)	0.005	(.0000259)	(4.59e-06)
park_l	.0271237	.0046681	5.810	0.000	.0179681	.0362794
per_sub	.0051694)	.0006395	8.084	0.000	.0039151	.0064236
per_road	.0037516	.0006395	8.965	0.000	.0029309	.0045724
j_dist	(2.65e-06)	1.11e-06	(2.383)	0.017	(4.83e-06)	(4.69e-07)
j_score	.0244394	.0012091	20.213	0.000	.022068	.0268109
free_l	(.0001752)	.000045	(3.894)	0.000	(.0002635)	(.000087)
free_0	.0194788	.0056461	3.450	0.001	.0084049	.0305526
free_2	2.76e-09	7.54e-10	3.662	0.000	1.28e-09	4.24e-09
rad_air	(.0070373)	.0015215	(4.625)	0.000	(.0100215)	(.0040532)
rad_cbd	(.0105495)	.0019721	(5.349)	0.000	(.0144173)	(.0066816)
constant	6.740303	.2851257	23.640	0.000	6.181077	7.299528

using a mapping software package. For locations with significant area, like parks, calculations were performed for each of the principal edges or corners and the minimum distance was selected from among those.

Transactions were removed from the data set if the data was incomplete and could not be corrected with other sources. Because the data included a wide range of average neighborhood incomes, average sale prices varied widely. To minimize the range of the data, properties with the highest and lowest 10% of sales prices were removed before calculation. School test scores came from the 1999 listings of the Texas Education Agency. Demographic variables relied on Census bureau data at the tract level. Municipal documents list park acreage. The final data set included approximately 1750 transactions.

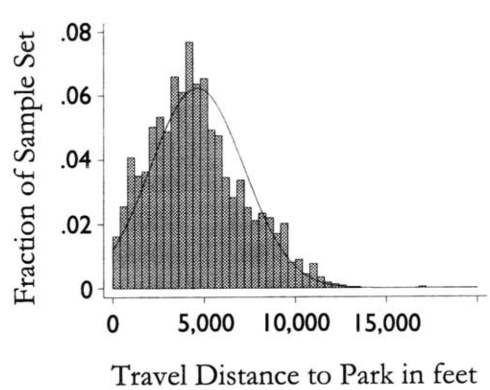
Results

The finished model includes 29 variables measuring attributes of the site and property, and uses the natural log of sale price as the dependent variable. (Illus. 3.3) Polynomial variables measure factors - square footage, age, lot size, and distance measurements - with expected nonlinear behavior. Other variables measure the impact of school quality or of park characteristics Coefficients and statistics for each of the individual variables in the model are listed in Illus. 3.4. The adjusted R^2 for the model is 0.7997, with an expected error of 0.2005.

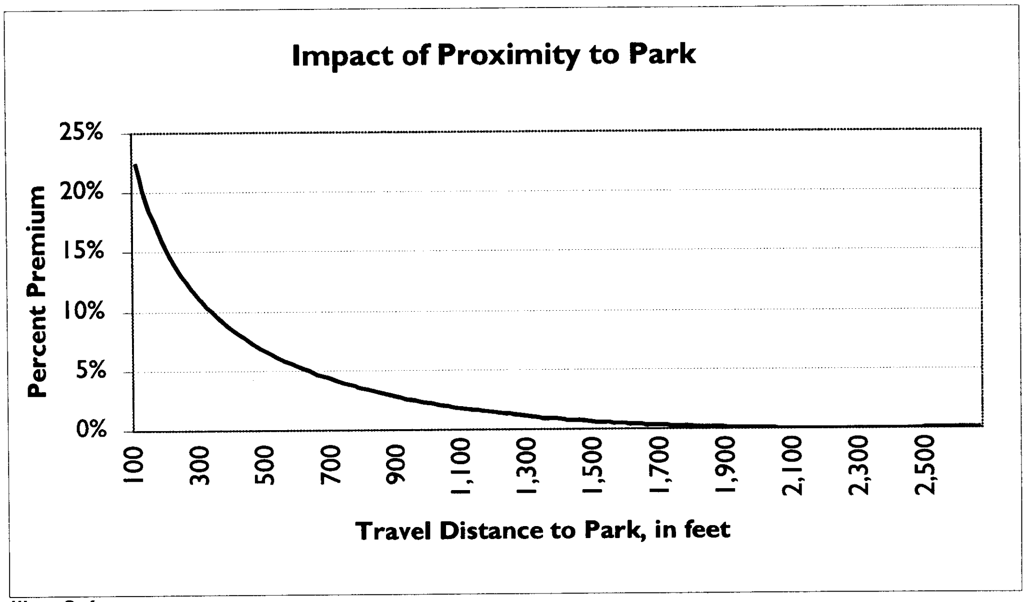
Though the initial focus of research was distance-based proximity valuation, many of the other variables used in the model have implications for the optimal design of neighborhoods. These include principally characteristics of the lot itself and of the surrounding neighborhood. The following section reviews the proximity findings, and details some additional results of the research.

Distance Measurements

The form of the proximity measure is critical in applying the results of the research to specific development sites. The municipality, toward which much of the earliest research on parks was focused, was concerned principally with the aggregate impact of parks on rent



Illus. 3.5



Illus. 3.6

rolls. The effect of minor attributes of neighborhood design could be expected to average out throughout the drawing radius of the park. A developer, in contrast, particularly one with a limited development parcel, has both the ability and the incentive to control these individual, minor aspects of neighborhood design. The design of a neighborhood to maximize net value depends on precise information about the marginal impact of individual planning decisions.

Distances were calculated using a basic GIS program with specially constructed program routines. Travel distance along roads and radial distance was calculated for each property and a series of points along the perimeter of the associated park. A minimum distance of 100 feet was selected for the analysis, based on the potential for measurement distortions at very short distances. Measurements were in hundredths of a mile, corresponding roughly to a 50-foot unit.

The software was intended principally for use by drivers, and the database does not include information on the pedestrian paths in some neighborhoods. Visual inspection suggests these paths are infrequent, however.

Distance from park	Share of Value
200'	41%
400'	63%
600'	76%
800'	85%
1000'	91%

Illus. 3.7

Share of total premium associated with proximity occurring within given travel distances from a park.

Distance

The critical variables, *dist* and *dist_1*, measure the impact of proximity to the park. (Illus. 3.5) Both variables were significant and robust in alternate models. The final form of the *dist_1* variable reflects an expectation that the benefits of proximity are non-linear and will decline at some point to zero. Percent price effects in Illus. 3.6 are compared against home values at a distance of 2650 feet.

The final specification, $1/dist^{0.1}$, favors strongly homes in the immediate vicinity of the park. Measured along a straight line from the park, 75% of the potential premium associated with a park occurs within 600 feet of the edge of the park, or the lengthwise distance of a conventional block. (Illus. 7) The price effects of parks are insignificant at a distance of approximately 1300 feet, the conventional estimate of a five-minute walking distance. A three-minute walk, or 800 feet, better delineates the park's principal area of influence. One reason for this rapid decline in value relative to accessibility may be that the benefits of proximity to neighborhood parks are strongly related to factors other than use, like scenic beauty or social prestige. Homes very close to the park will receive the bulk of these benefits, even though many other homes are within easy walking distance.

Distance to the park was not significantly correlated with either home sale price (-.0972) or the natural log of sale price (.0221). This suggests that the distance variable coefficients are unlikely to reflect simply specific housing attributes associated with more expensive homes but not measured by the existing variables.

To minimize the effects of externalities, parks in the study were typically distant from major commercial centers, arterials or collector streets, and therefore in the relative center of their neighborhood. Homes more than 2650 feet from the park may rise in value, because that distance implies proximity to other, non-measured amenities. An increase in home value outside a certain travel distance is present in and implied by this form of the model, but was consistent across traditional polynomial models as well. Models that included a distance specification for the second-closest park to each house were inconclusive.

Path characteristics

A principal assumption of the research specifications was that if the value of the neighborhood park depends on its accessibility to residents, then travel distance will be a better measure of proximity value than radial distance. Travel distance here is a proxy for travel cost, which depends also on the comfort and convenience of the path as well as its total length.

An additional variable, *detour*, measured the indirectness of the path to the park by calculating the difference between the actual travel and simple radial distance. A house on a road leading directly to the park would have a value of zero, while one 1000 feet of travel distance away from the park, of which distance half was the result of the form of the street grid, would have a value of 500. The hypothesis is that a park reached by a complicated, indirect path should be used less frequently than a more accessible park at a similar travel distance, and should therefore add less value to the property. The absolute difference between radial and travel distance was selected, rather than the difference as a percent of one of the underlying variables, because the aspect being measured - the willingness of residents to travel to the park and hence the value they place on it - is limited by actual rather than proportional distance.

The coefficient of the *detour* variable was (0.0000153), and its effect on total sale price, because of the specification, varies with respect to distance. The sale price of a property in a gridiron plan on a straight path to the park will differ from a property at the same travel distance but located on the diagonal by only 0.1% at a distance of 100 feet, but by 1.4% at a distance of 1300 feet. If lot area comprises roughly 20% of the contract price of the house, this amounts to a direct path premium of approximately 7% of the value of the land for a parcel located 1300 feet from the park. Indirect paths are a characteristic of dendritic street systems of arterials and cul-de-sacs, and may reveal a pedestrian bias against such plan types.

Simple travel distance is the principal determinant of value for parcels very close to the park, since the characteristics of the path - at least as defined by the specification - are not enough to detract from the value of the park. The characteristics of the path to a park is much more important for houses at the edge of the park's zone of influence, however. Homeowners who live at some distance from the park may be more likely to value it for active use, because they will pass by the park less frequently and derive fewer prestige benefits than residents living immediately adjacent to it. Because of this, those homeowners far away from the park should value the convenience of the travel path more, as a percent of the total benefits provided by the park, than the immediate neighbors of that park.

Park characteristics

An additional research hypothesis states that parks that are more visible to the neighborhood will be more appreciated by residents and as a result more valuable to them. This echoes Alexander's contention that the visibility of an amenity determines in part its value.

To test this, variables were constructed to categorize each study park by the percent of its perimeter devoted to five different uses. These include ordinary roads, subcollectors, private lots, alleys, and drainage channels. The argument is that parks bordered by streets will be more visible to the neighborhood than parks bordered by private lots or physical barriers. The variables were measured for each park in both percent and absolute terms. Of these, the percent of the perimeter comprising both ordinary roads and residential subcollectors were found to be significant and positive.

The coefficient of the *per_road* variable is 0.00375, while the *per_sub* coefficient is 0.00517. A property near a park which has 15% of its perimeter bordered by arterials - the fiftieth percentile in the sample set - will be worth 5.5% less than a similar property near a park in which 26% of the perimeter - the seventy-fifth percentile of sample set - is bordered by subcollectors.

The correlation of the *per_road* variable with the normalized sale price was 0.1008, while that of the *per_sub* variable was 0.1035. This suggests that the openness of the park perimeter is positively, but mildly, related to the overall value of homes. Based on the magnitude of the correlation, the results are unlikely to reflect simply different styles of park design associated with wealthier neighborhoods.

The *per_road* variable has a 0.26 correlation coefficient with house age, while the corresponding *per_sub* correlation coefficient is (0.19). Newer neighborhoods are therefore more likely to have parks bordered by subcollectors, while older neighborhoods have parks bordered by roads. This may reflect the fact that conventional municipal standards favor very large, accessible parks served by wide roads at the expense of small, neighborhood parks. Newer parks are therefore more likely to be bordered by subcollectors. However, the fact that both roads and subcollectors, while associated with parks of different vintages, have a strong, positive correlation with neighborhood home values suggests that the visibility of the park is a significant factor in its value.

Park size was positively and strongly correlated with sale prices. The coefficient of park size, .0271237 (t-stat 5.81), suggests that the increase of one acre in the size of a park has a marginal, positive impact of 2.75% in the contract price of a nearby home. One implication of the significance of this variable is that parks act to increase the general quality of the neighborhood and its prices, as well as increasing the value of properties in the park's immediate vicinity.

An additional implication is that the marginal effect on home prices of an increase in park size is small relative to the effect of proximity on homes adjacent to the park. This in turn implies that a network of small parks, which have a larger perimeter and so can have more houses in the vicinity, will generate larger premiums than a single, consolidated park. If only part of the price effect of acreage is due to the marginal benefits that come from having a larger park, while part reflects the value that comes simply from having additional park acreage in the neighborhood (as people generally like living in lush, attractive neighborhoods), the benefit of increasing the size of a park, relative to adding a second small park, will be even lower.

A series of small parks will have higher construction and infrastructure costs, however, and may be less efficient to operate over time. A municipality that captures few of the short-term financial benefits of a park (though it does receive higher property tax revenue over time) may not have an incentive to incur those added costs. Private developers, however, who can capture the greater value created by distributed parks at the time of sale, are better able to recoup those additional costs.

The model tested a number of other park attributes in addition to perimeter characteristics. Polynomial park size specifications were no more accurate than a linear form when used in conjunction with perimeter measurements. Dummy variables for the presence of specific amenities in the park - water features, soccer fields, tennis courts, basketball courts, and baseball diamonds - were inconclusive. The sum of these park amenity dummy variables had a 67% correlation with park acreage, suggesting that acreage alone may capture the principal benefits of scale in neighborhood parks. The preference of cities for building large, multi-activity parks that generate operating economies of scale also makes it difficult to isolate the effects of individual facilities on the value of the park to neighbors. A larger study, however, incorporating more parks with a range of different combinations of park functions, could in theory isolate any effect due to particular facilities. Information of that kind would be particularly valuable for the design of small, decentralized parks housing one activity each.

Lot Size

The effects of lot size on a home's total sale price and on the sale price per square foot of lot, while not part of the initial research topic, have design implications in neighborhoods with a heterogeneous housing stock. In particular, localized proximity effects around parks create a strong incentive to increase the density of adjacent development.

Lot effects are divided into three principal categories. First, the effect of *absolute lot size* determines the value of land itself. The effect of *relative lot size* on home price is to adjust the value of the property based on the size of nearby parcels. *Lot proportion* effects adjust the sale price of a home to reflect the benefit or detriment of different lot shapes.

Absolute lot size

The first variable used to measure lot effects, *lot*, records the square footage of the parcel. A linear variable was selected after testing numerous polynomial variations. Polynomial models were expected to show a positive but declining marginal value of lot area; that is, that the price of a large lot would rise less from the addition of an extra square foot of land than would a small lot, holding all else equal. The addition of a polynomial variable, while valid, did not significantly change values, however, and so was not included in the final specification.

The coefficient of lot, 0.0000251, has a very significant t-statistic of 7.953. For a 9,300 sf lot, the approximate average in the data set, the model estimates that 20.8% of the contract sale price of the property will be due to absolute lot area. The corresponding figure for a lot that is 10% larger, or 10,230 sf, is 22.65%. As might be expected, the value of lot area comprises a larger percentage of the sale price of homes on large lots than on small lots. These percentages are higher than those conventionally used in new development pro formas, which may reflect depreciation over time in the value of the physical housing stock and, correspondingly, its proportional contribution to total sale price.

Relative lot size

The second lot variable, *lot_dif*, measures the difference between the lot size and the mean lot size in the sample area surrounding the park. This represents a variation on the mean lot size hypothesis (Asabere and Colwell, 1985), which argues that lots will sell at a premium or discount depending on whether the lot is smaller or larger, respectively, than those of surrounding homes. The adage to 'buy the cheapest house in the neighborhood' is another variant of this argument.

The coefficient is -0.0022015, and has a t-statistic of 6.58. Based on this, a house on a lot that is 20% larger than others in the neighborhood will, all else equal, sell for 4.3% less than its size would imply per the *lot* variable. Similarly, a house on a lot that is 20% smaller than its neighbors will sell at a 4.5% premium. An alternate specification, using the nominal difference between actual lot size and mean neighborhood lot size, was comparable in its predictive ability. The result indicates that differences in price between lots of different size in the same neighborhood will be less than what a measurement of the absolute difference in lot sizes would predict. Neighborhoods develop a particular character based in part on the attributes of the properties in them, and that character moderates the impact on price of variations in the attributes of any individual property.

Lot proportion

The third lot variable, *ratio*, is the difference in feet between the width and the depth of the lot, and is used to measure the impact of lot proportion on sale price. The supporting hypothesis is that houses on narrow, deep lots, which offer more usable back yard relative to their unusable side and front yards, will be more valuable than comparable homes on wider lots of the same size. Also, because narrow lots have less frontage, and as a result will tend to have lower total infrastructure costs, they are less expensive to build. This cost difference associated with providing infrastructure for lots of different proportions will magnify the financial impact of the lot proportion hypothesis on the profitability of a development.

The data set did not include information on lot setbacks or other covenants restricting the use of land. Based on the hypothesis, a house with a very deep required front yard setback, for example, would place a higher value on total lot depth than a house with a small required front yard setback. If those setbacks vary widely across the data set, and are correlated with one or more of the lot variables, they could affect the results of this variable.

The absolute difference between dimensions was chosen over a true ratio specification (width/depth) because the hypothesis suggests that use value is the principal driver of the premium. The use of space depends first on its absolute dimensions with respect to the human form. Difference is therefore superior to the true ratio as a metric, particularly for the extremes of lot size.

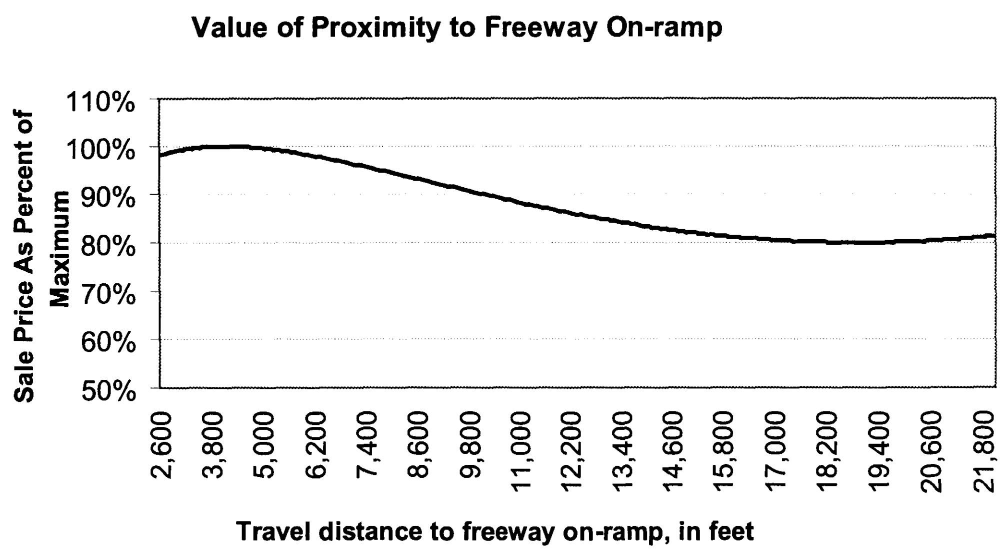
Lot proportion has several implications for design. First, street infrastructure comprises a substantial portion of development cost. Lots with limited frontage are correspondingly less costly.

Second, narrow lots permit more houses to access any individual street. When that street provides access to a highly localized amenity gradient, the use of narrow lots may substantially boost the net value of the proximity premium. Third, higher density on any street increases the opportunity for interaction among residents, and correspondingly the potential to develop a sense of community or social capital.

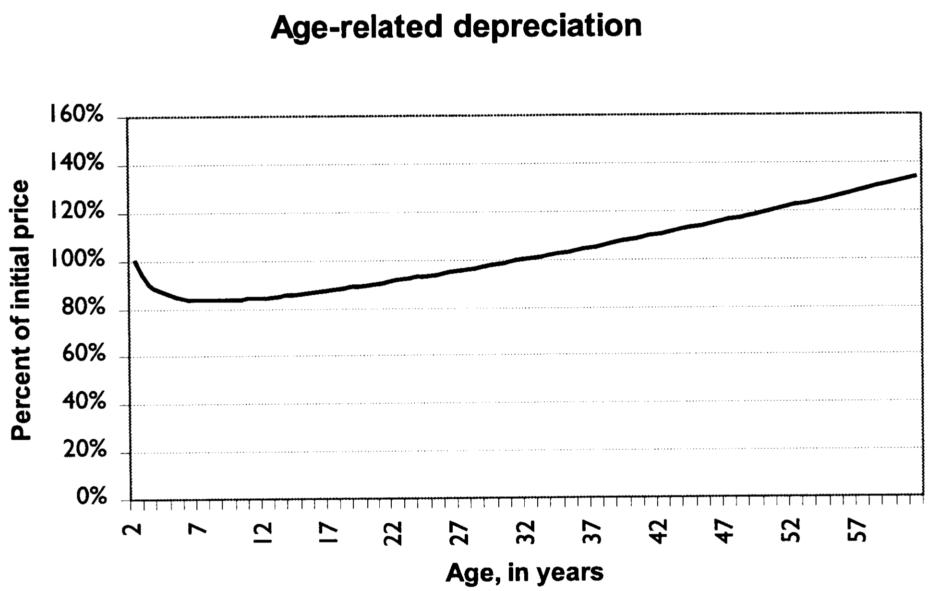
The coefficient of the lot proportion variable *ratio* is 0.0009079. That is, an increase in the width of the lot relative to its depth, holding lot size constant, lowers total sale price by approximately 0.1%. A more significant and reasonable change of ten feet lowers sale price by 0.9%. If land itself comprises 20% of the sale price of the home, this change in lot shape has reduced the value of the land by 4.5%. Because wide lots require more infrastructure, however, the actual effect on the net value of the development, and the developer's profit margin, will be higher. Holding lot area constant, narrower, deeper lots are more valuable to homebuyers, and less expensive for developers, than wider, shallower lots.

Other significant variables

A number of other variables with spatial implications had significant coefficients. Not all of these are significant for park valuation, but many provide additional information about the value of location at the very local level.



Illus. 3.9



Illus. 3.10

Schools

Homes near schools were more valuable than those further away. The coefficient for distance to the junior high school is small (0.00000265) but significant in the context of total variation across the sample set. A parcel one half mile from a junior high school will sell, all else equal, for 2.1% more than a house 2 miles away. School quality was measured by averaging 1999 standardized test pass rates for reading, writing and math for each school. These were significant with the expected sign. While many variations were tested, the final equation uses junior high school rather than elementary school data for both test scores and travel distance, because the junior high school data had a more normal distribution.

Freeways

In conventional suburban neighborhoods, proximity to macro-location variables depends on proximity to the freeway. To correct for these proximity effects in the data set, and to acknowledge the disamenity effects that freeways produce, a three variable specification was used to measure proximity. The three variables, representing travel distance, its square, and its square root, produce the rent gradient in Illus. 3.9. The specification peaks at approximately three quarters of a mile. The basic form of the gradient is similar to one produced by Waddell, Berry and Hoch (1993) using dummy variables and proximity to any portion of the freeway. The percent effect on sale price of travel distance to freeway entrances is more significant than the effects found in Waddell, Berry and Hoch. This may indicate that the benefit of proximity to the freeway entrance for travel, and the detriment caused by traffic and pollution near the entrance, are more significant effects on property values of the freeway than are ambient noise and pollution.

Property Age

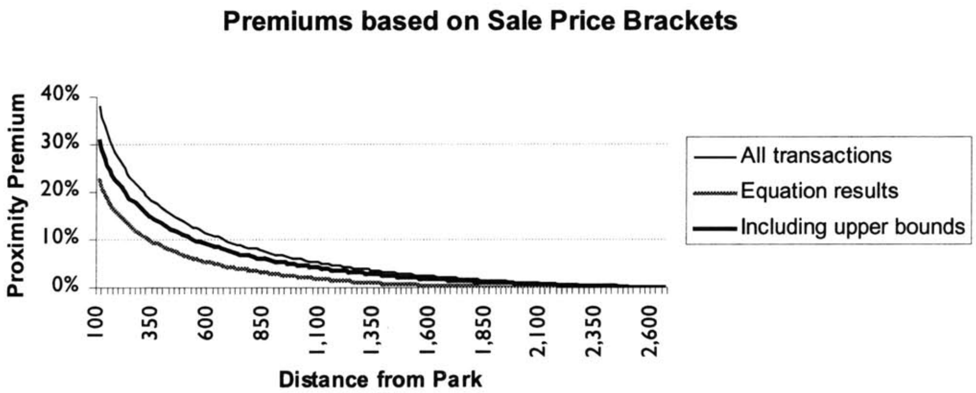
The age specifications are not directly relevant to the design of new neighborhoods. However, the variables correct for age-related depreciation in the sample set and suggest other possible data biases.

Some previous research (Waddell, Berry and Hoch) suggests that the market value of the physical attributes of a house depreciates in the years immediately after its construction, coming into favor again only after many years, when it becomes 'classic', if at all. The final specification, an age variable and a 1/age variable, indicates such a pattern. (Illus. 3.10) Maximum depreciation occurs within 10 years of construction. This may reflect either the rapid growth of location value in an expanding city or the rapid deterioration of housing stock after construction.

Implications and extrapolation

Additional inferences can be drawn about price behavior by using segmented portions of the data set. Such segmentations produce findings with lower accuracy than the primary equation, because the sample from which they are derived is smaller. However, they nonetheless suggest in many cases further implications for neighborhood form. In keeping with the concern of the thesis for site planning, many of these explorations address the interaction of lot size with other independent variables. Though the inferences relate to previously discussed topics, they are separated here due to their somewhat reduced reliability. House size, lot proportion, and proximity benefits are among the variables that exhibit relevant correlations.

One principal area of interest is whether there are specific density levels that maximize the value of the park. Higher density will permit more parcels to be within the geographic drawing radius of the amenity, and so should raise the net premium associated with it. Further, properties developed at higher densities - that is, on smaller lots - should place a greater value on the open space provided by the park.



Illus. 3.11

Sale price and park preference

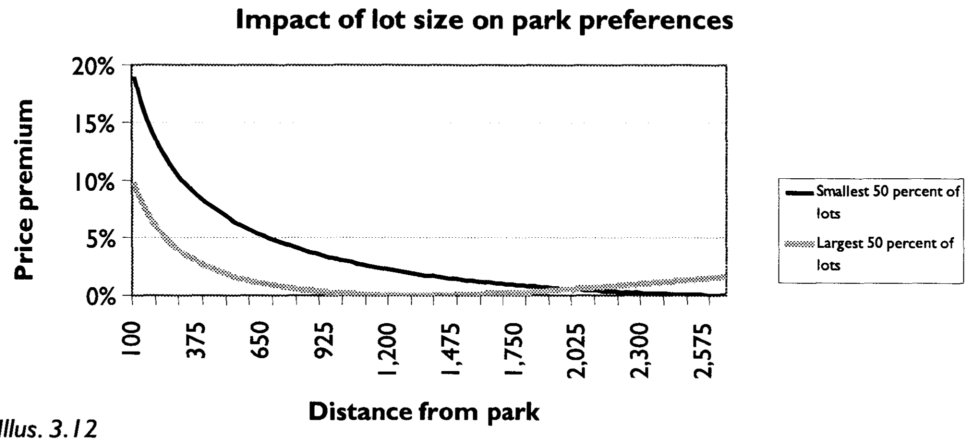
Regressions were run with subsets of the data to attempt to isolate differences in the preference for parks and park amenities that might correlate with home value. In addition to the final equation, which removed the upper and lower 10% of transaction prices, regressions were run with the entire data set, and with either the upper or lower bounds included. Those results are illustrated in Illus. 3.11.

While the final equation indicated that a location within 100 feet of the park added 22.3% to the value of the home, that premium rose to approximately 31% when either the upper or lower 10% of sale prices was included. It was expected that proximity would be more valuable to houses in the lower bound than in the general data set. A portion of the value of a nearby park for homeowners is likely to be fixed, independent of the value of their home. The lower the value of the home, the larger the effect on the overall price of the home this fixed component of location value will have.

It was not expected that the same result would hold when the most expensive 10% of parcels were included. The data set included an extensive upper tail, with the top one percent of homes more than three standard deviations from the mean sale price in the data set. Large premiums paid by owners of those properties for proximity to parks may have translated to large percent premiums in the final equation.

Lot size and park preferences

One hypothesis about the behavior of lot size is that homes on smaller parcels will value proximity to the park more than homes on larger parcels. Privately owned yard space acts as a partial substitute for public park space. Residents



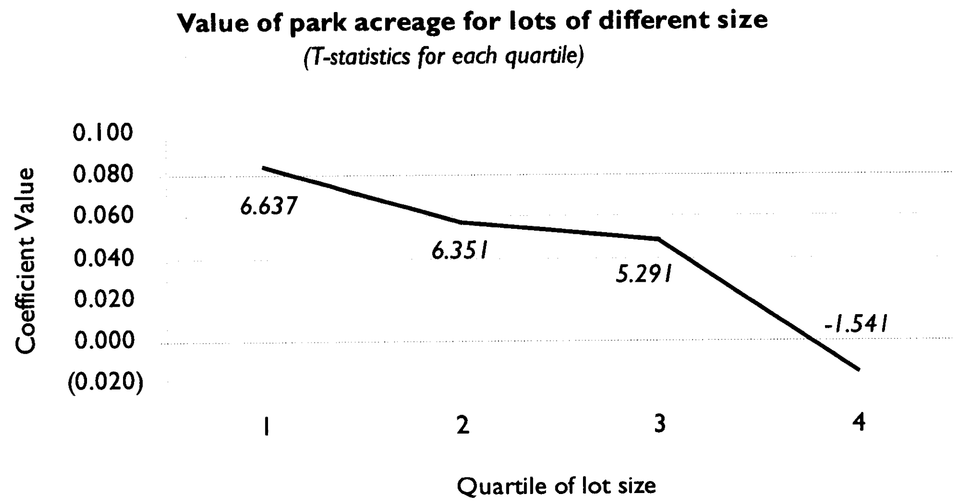
Illus. 3.12

with extensive yards will have less need of a park within walking distance, because the activities that a neighborhood park provides can more easily be accommodated on their private property. If true, this would imply that, to maximize the value of land in a new development with a park, the smallest lots should be located closest to that park. To test this, the data set was divided in both halves and quartiles based on lot size, and regressions run for each group.

The proximity premium at 100 feet for parcels with the smallest half of lot areas, as a percent of total transaction value, was 18.8%. The largest half, in contrast, had a peak value of only 9.56%. (Illus. 3.12) In addition, the coefficient of park acreage was 0.06446 for the smallest 50 percent, and only 0.01631 for the largest 50 percent, or almost four times less. That is, an increase in park size of one acre is associated with home prices that are 6.7% higher for small parcels but only 1.65% higher for large parcels.

A division of the data set into quartiles based on lot size shows a similar decline in the marginal value of park acreage to homes on larger lots. (Illus. 3.13) The relative insignificance of the coefficient for the top quartile, those with more than 11,900 sf of lot area, suggests that substitution of private yard space for public park space does occur.

The first finding supports the hypothesis that park space is valued more highly by the owners of smaller lots. The second set of findings reinforces this, indicating a clear correlation between lot size and a preference for park space, and indicating the ambivalence of owners of the largest lots toward additional public open space.



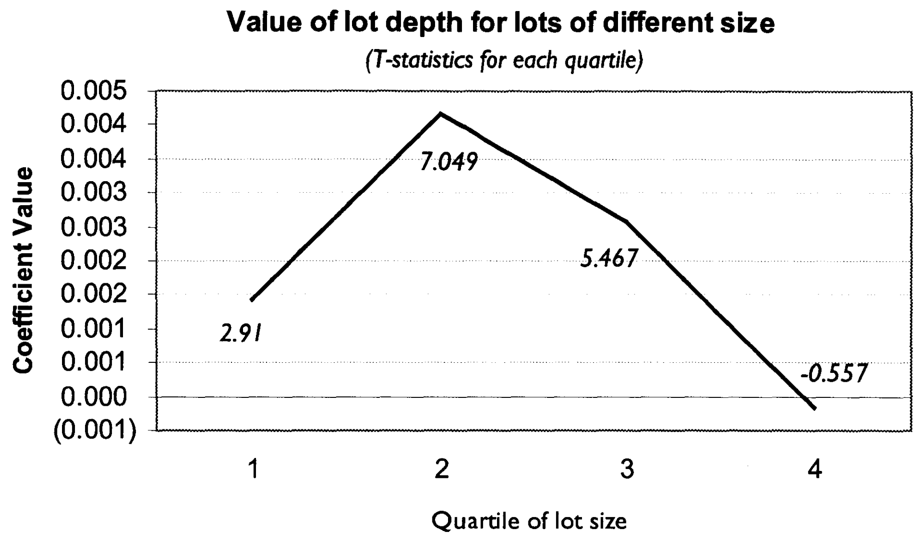
Illus. 3.13

Absolute lot Size

The value of lot size, while not polynomial, is also not strictly linear with respect to all sizes. A division of the data set yields a coefficient of 0.000045 for the half of the data set with the smallest lots, and a coefficient of 0.0000228 for the largest lots. That is, an additional 100 square feet of lot area adds 0.45% to the value of a small lot and 0.228% to the value of a large lot. The findings indicate that, exclusive of other costs, the value of land per square foot will be highest to homebuyers when divided into small lots than into fewer, larger lots.

Lot Proportion

The lot proportion coefficient in the principal equation is 0.009079, indicating that, holding lot size equal and ignoring possible effects from required setbacks, residents prefer additional lot depth to additional lot width. A division of the data set into quartiles based on lot size produces a more refined conclusion. (Illus. 3.14) The quartile of lots with the smallest areas have no great preference for width versus depth. Because lot width and lot area are strongly correlated (0.86), this may indicate, reasonably, a higher marginal value of lot width for comparatively narrow lots. The data set is sparse for very narrow lots, the kind decried by progressive planners. If the least expensive, and presumably smallest, 10% of houses are included in the analysis, the coefficient for lot proportion rises by 63%, indicating a greater preference for lot depth. A data set that included more narrow parcels might show an even



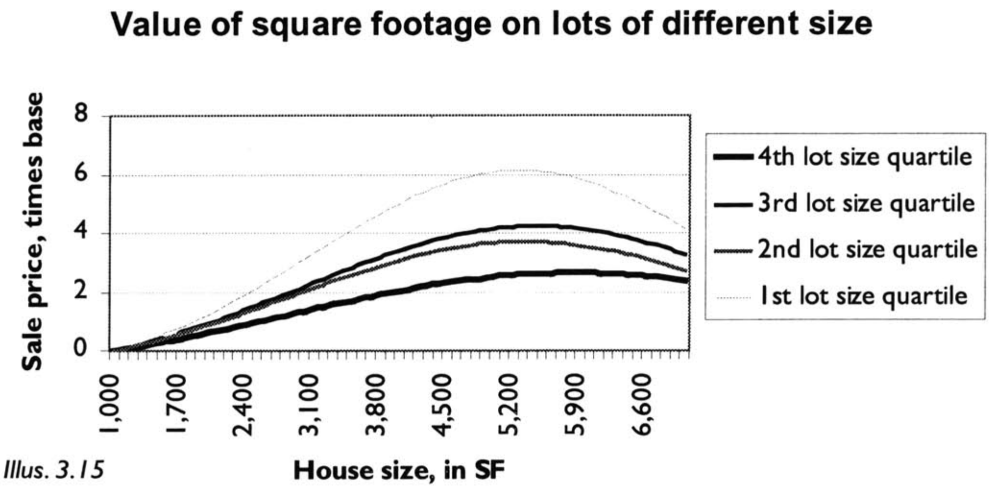
Illus. 3.14

higher preference for depth. The second quartile, lots between 7659 and 9306 sf, has the strongest preference for additional lot depth, and the third quartile a positive but less strong preference. The top quartile, lots over 11,900 sf, is ambivalent with respect to lot width. Beyond a certain lot size, when both width and depth are satisfactory, homeowners may be indifferent in how additional lot area is distributed. Below that top range, however, homeowners prefer deeper, narrower lots to shallower, wider ones.

House area and lot size

One question the data set raises is whether, if the higher inferred value per square foot of smaller parcels relative to larger ones, the physical attributes of the house will comprise a larger percentage of the sale price of houses on large lots than for houses on small lots. To test this, the coefficient values for *sf* and *sf_2* were graphed for parcels based on lot size quartiles, to illustrate the marginal effect of house area for different transaction prices. (Illus. 3.15) Values are multiples of a base price that excludes house area. The data set indicates that house area comprises a substantially larger portion of total property value on small lots than on large ones.

The finding suggest that the division of a development parcel into small lots will permit creation of the highest possible value. As previously indicated, land is more valuable per square foot when divided into small parcels, and the value of that land does not simply reflect



Illus. 3.15

the substitution of land for structure by homebuyers.

Travel Distance

Conventional estimates of travel distance have used actual radial measurements to determine the drawing radius of location amenities. (Adams, 1929, Calthorpe, 1989). The research, in contrast, indicates that travel distance is a more meaningful and accurate measurement of proximity. The appropriate tool for delineating the value of proximity is not the radius but the iso transportation cost contour (Yinger, 1992), a line connecting points of equivalent travel time from a given center.

The iso-contour differs substantially from the radial measurement both in its form and in the total area of land within an amenity's drawing radius. While points of equivalent distance calculated using a radial measurement will approximate a circle, points calculated using iso-contours will - at least in a gridiron plan - resemble a diamond. For a point amenity, for example - that is, a theoretical location amenity without area - , a measurement based on iso-transportation cost contours produces an effective zone of influence for that amenity that is 57% smaller than the corresponding radial measurement. There is a corresponding reduction in the potential premium associated with that amenity. This means that neighborhoods designed using radial measures of proximity will tend to sharply overestimate the drawing radius of parks and other amenities. If those calculations are used to determine expected premiums in new neighborhoods, one or all of three things will happen. First, parks that are not economically justifiable will appear to be so, encouraging developers to make bad investments. Second, some parcels that the developer believes are within the drawing radius of the park will be outside it, reducing the quality of life for those homeowners without easy access to recreation space. Third, developer will overprice a majority of lots in the neighborhood based on that mistaken assessment of proximity. This will reduce sales velocity and thereby generate additional development costs.

When travel distance to the park is the relevant metric, street and path plans should provide the most direct possible route to the park for every house. A street grid that truly optimized travel distance would resemble a circular plan, with an array of paths or roads heading out from the center in all directions. The iso-contours resulting from such a plan would come to resemble contours derived using a radial measurement, because the travel distance and radial distance would be the same.

The implausibility of the above approach means that other methods for increasing the directness of travel paths are necessary. Part of the reason that paths are inefficient is that they involve detours around blocks or along streets. Porous street grids, which minimize necessary detours by reducing the size of each block, are one obvious solution to this problem. If the only means of making a through-path is to build a conventional street, however, this approach will not be viable. Those cost of those roads will overwhelm the premium generated by the park, and the roads themselves will consume some of the most valuable land in the park's immediate vicinity.

Pedestrian paths present a better solution. When connected to parks, they greatly increase the pedestrian accessibility of those parks. This allows a park to be reached easily and quickly, and eliminates the need for extensive, costly parking areas at the park. Pedestrian paths take little space relative to what a street requires, are easy to construct, and can be fit easily between houses. Unlike streets, they don't produce difficult corner lots.

Pedestrian paths have two principal problems. The first is that adjacent homeowners, preferring absolute privacy, erect high wooden privacy fences along the edge of the walk. This makes the now deeply shadowed walkway unpleasant to use and can make it appear unsafe. Second, and in part for the preceding reason, pedestrian paths are illegal or discouraged in many municipalities. As a result, their inclusion requires additional paperwork, labor and expense on the part of planners, designers and developers. Using conventional analysis, the benefits of those paths would be difficult to justify relative to their all too apparent cost in time and money. Proximity rent gradient-based analyses, however, indicate value in the benefits that pedestrian paths can provide that can justify their added cost.

The findings with respect to park perimeter characteristics affect an ongoing debate about the design of parks. The effective cost of a park with perimeter ring road must include one half of the cost of the road running along its perimeter, as well as its physical construction and maintenance expense. Parks with abutting lots have substantially lower associated infrastructure costs, and for this reason are often favored by developers in new neighborhoods. This strategy, however, imposes several additional costs. First, it creates significant privacy, noise and safety concerns for abutting homeowners. Second, it compromises the park's character as public space. Third, it reduces the park's visibility to the neighborhood, which may reduce the park's value to non-abutting residents of the neighborhood. The research findings suggest that these costs are substantial. Not only does research suggest that park-abutting properties have lower values than similar properties facing the park across a street, but abutting properties appear to reduce the value of the park to all parcels within walking distance.

Conclusions

If permitted by municipal codes and regulations, private developers can add parks to new neighborhoods that make those neighborhoods more attractive, and that improve the quality of life for residents. More attractive neighborhoods will have higher sales velocity relative to conventional developments, which in turn reduces total project cost. Parks generate sale price premiums that can offset, or more than offset, the cost of constructing and maintaining those parks.

Parks have traditionally been considered a cost center in neighborhood planning, an amenity that must be provided by local government or required of private developers by statute in order to be feasible. The research, in contrast, suggests that providing parks in new neighborhoods offers clear financial benefits to developers, that those benefits are predictable using objective research methods, and that they can be captured through careful design and development practice.

Appendix A

Table of correlation coefficients

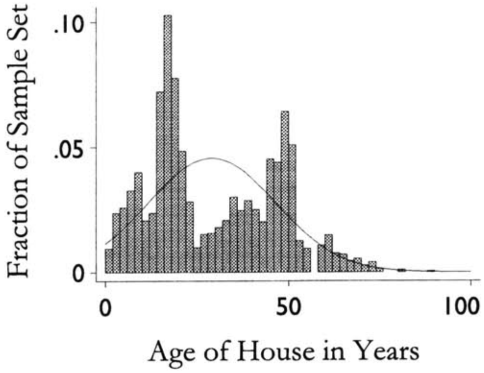
	ln_salep	sale	sf	sf_2	sf_avg	sf_dev	age	age_d	lot	lot_dif
ln_salep	1.0000									
sale	(0.0782)	1.0000								
sf	0.8332	0.0101	1.0000							
sf_2	0.7838	(0.0032)	0.9705	1.0000						
sf_avg	0.0924	(0.0149)	0.1061	0.0964	1.0000					
sf_dev	0.6481	0.0357	0.7066	0.6011	(0.4403)	1.0000				
age	(0.0363)	(0.0269)	(0.2766)	(0.2581)	0.1456	(0.3354)	1.0000			
age_d	0.2672	(0.0865)	0.3439	0.3951	(0.0423)	0.2137	(0.5131)	1.0000		
lot	0.3303	(0.0066)	0.3084	0.2901	0.2151	0.1458	0.2765	(0.0748)	1.0000	
lot_dif	0.2482	(0.0088)	0.2985	0.2872	0.0391	0.2141	0.0818	(0.0257)	0.7996	1.0000
ratio	0.2268	(0.0393)	0.0579	0.0880	0.0200	(0.0235)	0.2762	0.0481	0.1043	0.0236
bed	0.4409	0.0032	0.6332	0.5938	0.0106	0.5105	(0.3329)	0.2236	0.1657	0.2426
bath	0.6914	0.0092	0.8207	0.7974	0.0576	0.6053	(0.3172)	0.3169	0.2189	0.2284
fp	0.6256	(0.0101)	0.6271	0.5921	0.0598	0.5018	(0.2481)	0.2206	0.2100	0.2251
d_story	0.4624	0.0107	0.5267	0.5206	(0.0549)	0.3934	(0.2905)	0.2924	(0.0902)	0.0320
cvp	0.3480	0.0203	0.4077	0.3659	0.0039	0.3938	(0.3197)	0.1718	0.1307	0.1604
d_pool	0.2144	0.0329	0.3016	0.2558	0.0212	0.2521	(0.1562)	(0.0343)	0.1530	0.1863
dist	0.0136	0.0173	0.1280	0.0739	0.1650	0.0767	(0.2958)	0.0810	0.1140	0.0811
dist_1	0.0223	(0.0110)	(0.1196)	(0.0760)	(0.0491)	(0.1036)	0.3070	(0.0849)	(0.0559)	(0.0743)
detour	(0.1631)	(0.0352)	(0.0741)	(0.1010)	(0.0270)	0.0133	(0.2751)	0.0986	(0.0700)	(0.0283)
park_1	0.4318	0.0471	0.2635	0.2245	(0.2072)	0.4211	(0.1578)	0.1103	(0.0521)	(0.0005)
per_sub	0.1027	(0.0031)	0.1012	0.0460	0.1944	0.1085	(0.1949)	0.0735	(0.0396)	0.0007
per_road	0.1021	0.0432	0.0168	0.0403	0.0356	(0.0775)	0.2600	(0.0708)	0.2567	0.0187
j_dist	(0.0642)	0.0848	0.0304	0.0175	(0.0696)	0.0551	(0.2754)	0.1061	(0.1579)	0.0501
j_score	0.2470	0.0286	0.2391	0.1801	(0.2334)	0.4161	(0.5358)	0.2216	(0.3591)	(0.0200)
free_1	(0.2372)	0.0338	(0.0957)	(0.1432)	(0.2010)	0.1514	(0.5674)	0.1063	(0.2480)	(0.0294)
free_0	(0.2482)	0.0394	(0.0973)	(0.1460)	(0.2074)	0.1552	(0.5663)	0.1031	(0.2608)	(0.0291)
free_2	(0.2111)	0.0228	(0.0950)	(0.1372)	(0.1862)	0.1339	(0.5347)	0.1027	(0.2161)	(0.0356)
rad_air	(0.0354)	(0.0227)	0.0152	0.0320	0.1893	(0.1843)	0.2028	(0.0216)	0.0417	(0.0049)
rad_cbd	(0.3224)	0.0462	(0.1312)	(0.1772)	(0.2036)	0.1081	(0.5295)	0.0471	(0.2635)	0.0059

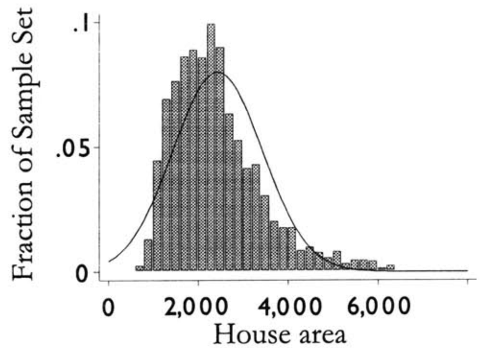
	ratio	bed	bath	fp	d_story	cvp	d_pool	dist	dist_1	detour
ratio	1.0000									
bed	(0.1002)	1.0000								
bath	0.0256	0.6842	1.0000							
fp	0.0565	0.3673	0.5373	1.0000						
d_story	0.1366	0.3433	0.4944	0.3691	1.0000					
cvp	(0.0949)	0.3429	0.4108	0.3790	0.1942	1.0000				
d_pool	(0.1183)	0.2800	0.2985	0.2591	0.1107	0.1917	1.0000			
dist	(0.1671)	0.1491	0.1333	0.1042	0.1113	0.1449	0.1424	1.0000		
dist_1	0.1361	(0.1728)	(0.1380)	(0.0673)	(0.1175)	(0.1190)	(0.1327)	(0.8527)	1.0000	
detour	(0.1232)	0.0563	(0.0278)	(0.0538)	0.0074	0.0575	0.0435	0.5930	(0.5668)	1.0000
park_1	0.0181	0.1368	0.2540	0.3343	0.2138	0.1828	0.0467	(0.1093)	0.1416	(0.2176)
per_sub	(0.0714)	0.1488	0.0953	0.1214	(0.0455)	0.0665	0.0457	0.1839	(0.1995)	0.1274
per_road	0.0740	(0.1275)	(0.0117)	0.0147	(0.0548)	(0.0095)	(0.0265)	(0.1774)	0.2533	(0.2548)
j_dist	(0.0989)	0.0711	0.0391	0.0770	0.1733	0.0525	0.0643	0.2496	(0.2211)	0.1993
j_score	(0.0946)	0.2680	0.2570	0.2898	0.3560	0.2403	0.1257	0.1496	(0.2054)	0.2379
free_1	(0.3607)	0.0814	(0.0726)	(0.0105)	(0.0258)	0.1492	0.0653	0.2117	(0.1664)	0.3014
free_0	(0.3675)	0.0860	(0.0741)	(0.0183)	(0.0247)	0.1482	0.0668	0.1866	(0.1364)	0.2755
free_2	(0.3363)	0.0640	(0.0735)	(0.0025)	(0.0368)	0.1406	0.0569	0.2331	(0.1980)	0.3233
rad_air	0.1337	(0.0533)	(0.0110)	(0.0300)	0.0024	(0.0702)	(0.0022)	0.0557	(0.0875)	0.1124
rad_cbd	(0.3714)	0.1048	(0.0689)	(0.0501)	(0.0181)	0.1318	0.1058	0.2577	(0.2392)	0.2727

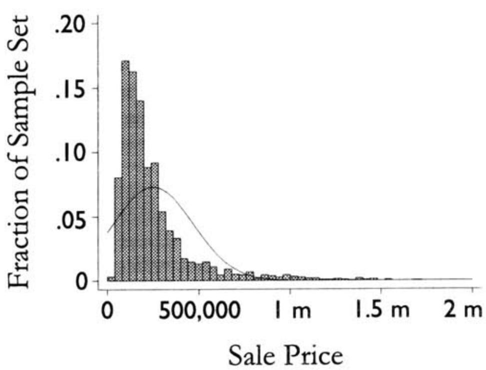
	park_1	per_art	per_rd	j_dist	j_score	free_1	free_0	free_2	rad_air	rad_cbd
park_1	1.0000									
per_sub	(0.0415)	1.0000								
per_road	0.2893	(0.7409)	1.0000							
j_dist	0.0037	(0.0707)	(0.0374)	1.0000						
j_score	0.3115	0.3123	(0.4987)	0.3759	1.0000					
free_1	0.0459	0.2414	(0.3021)	0.2348	0.5296	1.0000				
free_0	0.0426	0.2186	(0.2893)	0.2575	0.5166	0.9916	1.0000			
free_2	0.0414	0.2694	(0.3092)	0.1679	0.5162	0.9773	0.9433	1.0000		
rad_air	(0.3341)	(0.1305)	0.0630	0.0608	(0.2388)	(0.3957)	(0.3736)	(0.4180)	1.0000	
rad_cbd	0.0375	0.1499	(0.2764)	0.3062	0.4201	0.6544	0.6623	0.6009	(0.4225)	1.0000

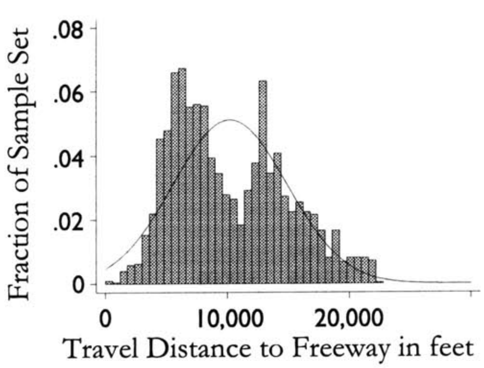
Appendix B

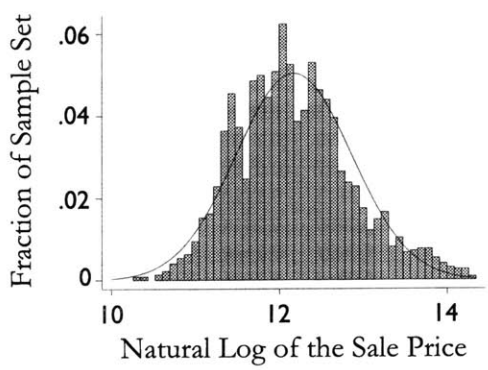
Graphs showing distribution of selected variables











Appendix C

A number of variables were tested in addition to the ones included in the final model. Not listed here are permutations of several of the variables - lot size, for example - constructed in an effort to better describe the effects of the variables. Some of those variables are included below.

Sale Information

List price
List date
Sale date
Sale price

Lot Characteristics

Area
Width
Depth
Dummy - culdesac
Dummy - corner lot
Dummy - park frontage
Dummy - abutment to park
Dummy - on arterial

Linear feet of park bordered by road
Linear feet of park bordered by arterials
Linear feet of park bordered by lots
Linear feet of park bordered by alleys
Linear feet of park bordered by other

Percent of perimeter in roads
Percent of perimeter in arterials
Percent of perimeter in lots
Percent of perimeter in alleys
Percent of perimeter in other

House Characteristics

Square footage
No.of stories
No. of covered parking spaces
No. of living areas
No. of bedrooms
No. of full baths
No. of half baths
No. of fireplaces
Dummy - pool
Age of house
Age of house squared
Age of house cubed

Park characteristics

Address
City
Area (acres)
Playground
Picnic area
Soccer field
Basketball court
Tennis court
Baseball diamond
Decorative water feature
Stormwater drainage pool

Travel distance to primary park
Radial distance to primary park
Travel distance to secondary park
Radial distance to secondary park

Elementary school

District
Address
Radial distance to house
Travel distance to house
Reading pass rate
Writing pass rate
Math pass rate
Average pass rate

Travel distance to elementary school
Radial distance to elementary school

Junior high school

District
Address
Radial distance to house
Travel distance to house
Reading pass rate
Writing pass rate

Math pass rate
Average pass rate

Travel distance to junior high school
Radial distance to junior high school

Senior high school

District
Address
Radial distance to house
Travel distance to house
Reading pass rate
Writing pass rate
Math pass rate
Average pass rate

Travel distance to senior high school
Radial distance to senior high school

Location Variables

Travel distance to freeway on-ramp
Radial distance to freeway on-ramp
Radial distance to central business district
Radial distance to airport

Geographic Data

Mapsco Map no.
Mapsco Grid letter

Municipal Data

Dummy - Carrollton
Dummy - Coppell
Dummy - Dallas
Dummy - Fort Worth
Dummy - Richardson
Dummy - Bedford
Dummy - Hurst
Dummy - University Park

City tax rate
County tax rate
District tax rate

Census Tract Variables

Average commute
Percentage black population
Percentage hispanic population
Percentage of units that are rentals
Average income
Population density per square acre
Household size

Percent under age 14
Percent between age 15 and 24
Percent between age 25 and 44
Percent between age 45 and 54
Percent over age 55
Median population age

Percent of housing built between 1980-89
Percent of housing built between 1970-79
Percent of housing built between 1960-69
Percent of housing built between 1950-59
Percent of housing built before 1949
Ratio of 1999 to 1989 tract income

Neighborhood Variables

Mean lot size in neighborhood sample
Mean sale price in neighborhood sample

Appendix D

Note on assessment methodologies

In addressing models of home value, it is worth considering current assessment techniques used in Texas. Counties and municipalities in Texas, and across the country, estimate house value using both regression equations and on-site appraisal based on comparables. Texas is a non-disclosure state, which means that the price and characteristics of a house need not be registered with public agencies at the time of sale. As a result, counties like Dallas rely for their data on the same multiple listing service data used by brokers. To the physical attributes of the house, Dallas adds social and spatial variables, and one of 3200 neighborhood designations. Periodic site inspection supplements recorded transaction data, and homeowner complaints prompt further revisions. In the case of new developments, which may be sold directly by the developer rather than through a broker, the city dispatches agents to model homes and construction sites, to review the characteristics of the property and estimate its finished value.

An effect of this privacy is that homeowners have a strong incentive to conceal information, and the legal means to do so. If the home is sold privately between parties, and does not enter the database used by the brokerage community or the assessor's office, additions or renovations can be hidden for long periods of time. Private sales become more attractive, presumably, as the discrepancy between the assessed and the actual market value grows. Even when brokers are involved, however, the same moral hazard exists. "TAD [Tarrant Appraisal District] has SF wrong," opened one recent brokerage listing in the initial data pool, judiciously declining to correct the error.

As a result, database analyses may tend to underestimate the value of homes, particularly the value of renovations and additions. Alterations to new homes, those made at the buyers request after purchase, are another factor. The assessor's office bases its assessments of new construction on site inspections and marketing data printed before construction. Changes made during the construction, supplementing the basic house design, are missed.

City appraisal values consistently undershoot the actual market value, aiming for a percent factor that was 90% in the late 1980s and is presumably higher today. If actual values follow a normal bell distribution with respect to the regression model, and the target was actual home value, the city would consistently over-assess half its population. Homeowners being noticeably more likely to complain of over- rather than under-assessment, the city could then face several hundred thousand complaints per year. Preferring to avoid this scenario, the city undershoots its assessments, and makes up the difference through a higher base tax rate than would otherwise be necessary.

This model creates an incentive for local governments to supplement variable, sometimes questionable data on the physical characteristics of properties with more easily verifiable data on location value. The neighborhood categorization method is one approach, but will tend to miss significant variations within the neighborhood. The risk of models, particularly ones with substantial financial impacts, is that they encourage optimization to the standards of the model - 'gaming' the system, as it were. As the example of Dallas suggests, this can produce dismal incentive systems, and potentially lower the quality of the built environment. Since the size of modern cities makes assessment models necessary, the only alternative is to improve the quality of those models, ensuring they reflect not just the obvious components of home value, but the values that affect home value by affecting the quality of the surrounding neighborhood and of the city.

Appendix E - Distribution data

ln_salep

	Percentiles	Outliers
1%	10.799	10.292
5%	11.156	10.308
10%	11.344	10.373
25%	11.695	10.413
50%	12.106	
75%	12.577	14.204
90%	13.112	14.234
95%	13.455	14.260
99%	13.963	14.343
Mean	12.172	
Std. Dev.	0.6892	
Variance	0.4750	
Skewness	0.4287	
Kurtosis	3.0510	

sale

	Percentiles	Outliers
1%	1	1
5%	1	1
10%	2	1
25%	4	1
50%	6	
75%	8	10
90%	9	10
95%	10	10
99%	10	10
Mean	5.924	
Std. Dev.	2.712	
Variance	7.353	
Skewness	(0.154)	
Kurtosis	1.898	

sf

	Percentiles	Outliers
1%	910	708
5%	1,171	720
10%	1,345	735
25%	1,696	752
50%	2,270	
75%	2,915	6,278
90%	3,774	6,291
95%	4,433	6,300
99%	5,667	6,910
Mean	2,428.22	
Std. Dev.	998.68	
Variance	997,366.2	
Skewness	1.131	
Kurtosis	4.508	

sf_2

	Percentiles	Outliers
1%	828,100	501,264
5%	1,371,241	518,400
10%	1,809,025	540,225
25%	2,876,416	565,504
50%	5,152,901	
75%	8,500,141	3.94e
90%	1.42e	3.96e
95%	1.97e	3.97e
99%	3.21e	4.77e
Mean	6,893,173	
Std. Dev.	6,160,555	
Variance	3.80e	
Skewness	2.318	
Kurtosis	9.781	

sf_avg

	Percentiles	Outliers
1%	1,433.8	1,433.8
5%	1,433.8	1,433.8
10%	1,444.5	1,433.8
25%	1,859.7	565,504
50%	2,679.7	
75%	2,817.6	3,253.2
90%	3,252.2	3,253.2
95%	3,252.2	3,253.2
99%	3,252.2	3,253.2
Mean	2,428.0	
Std. Dev.	590.9	
Variance	349,625.3	
Skewness	(0.4259)	
Kurtosis	1.94	

sf_dev

	Percentiles	Outliers
1%	(220.97)	(298.26)
5%	(113.98)	(289.26)
10%	(84.03)	(272.18)
25%	(41.48)	(270.54)
50%	(6.75)	
75%	21.99	75.59
90%	43.40	75.71
95%	50.90	75.92
99%	66.84	77.04
Mean	(16.04)	
Std. Dev.	55.05	
Variance	33030.64	
Skewness	(1.38)	
Kurtosis	5.94	

age

	Percentiles	Outliers
1%	2	1
5%	5	1
10%	8	1
25%	16	1
50%	23	
75%	45	75
90%	50	80
95%	59	80
99%	69	89
Mean	29.06	
Std. Dev.	17.45	
Variance	304.6	
Skewness	0.380	
Kurtosis	2.11	

1/age

	Percentiles	Outliers
1%	0.1449	0.0112
5%	0.0169	0.0125
10%	0.0200	0.0125
25%	0.0222	0.0133
50%	0.0435	
75%	0.0625	1
90%	0.1250	1
95%	0.2000	1
99%	0.5000	1
Mean	0.0688	
Std. Dev.	0.1121	
Variance	0.0126	
Skewness	5.8041	
Kurtosis	43.896	

lot		
	Percentiles	Outliers
1%	3,200	1,932
5%	4,920	2,296
10%	6,726	2,560
25%	7,659	2,576
50%	9,306	
75%	11,900	34,380
90%	16,533	36,260
95%	18,850	36,670
99%	25,578	36,800
Mean	10,363	
Std. Dev.	4,407.5	
Variance	1.94e	
Skewness	1.6625	
Kurtosis	7.5835	

dev_lota		
	Percentiles	Outliers
1%	36.241	19.640
5%	54.512	24.809
10%	67.837	25.028
25%	78.561	25.582
50%	96.103	
75%	114.926	317.264
90%	135.864	327.131
95%	157.239	348.921
99%	213.425	361.771
Mean	100	
Std. Dev.	33.892	
Variance	1148.733	
Skewness	1.736	
Kurtosis	10.829	

ratio		
	Percentiles	Outliers
1%	6	0
5%	19	0
10%	29	0
25%	40	0
50%	53	
75%	75	180
90%	90	187.89
95%	100	201
99%	139	409
Mean	57.85	
Std. Dev.	27.15	
Variance	737.203	
Skewness	1.632	
Kurtosis	16.48	

bed		
	Percentiles	Outliers
1%	2	1
5%	2	1
10%	3	1
25%	3	2
50%	3	
75%	4	6
90%	4	6
95%	4	6
99%	5	6
Mean	3.396	
Std. Dev.	0.722	
Variance	0.5214	
Skewness	0.0929	
Kurtosis	3.23	

bath

	Percentiles	Outliers
1%	1	1
5%	1	1
10%	2	1
25%	2	2
50%	2.5	
75%	3	6
90%	4	6
95%	4.5	6
99%	5.5	6
Mean	3.396	
Std. Dev.	0.722	
Variance	0.521	
Skewness	0.093	
Kurtosis	3.230	

fp

	Percentiles	Outliers
1%	0	0
5%	0	0
10%	0	0
25%	1	0
50%	1	
75%	2	4
90%	2	4
95%	3	4
99%	3	5
Mean	1.9277	
Std. Dev.	0.5908	
Variance	0.3491	
Skewness	(0.883)	
Kurtosis	8.0940	

d_story

	Percentiles	Outliers
1%	0	0
5%	0	0
10%	0	0
25%	0	0
50%	0	
75%	1	1
90%	1	1
95%	1	1
99%	1	1
Mean	0.2706	
Std. Dev.	0.4444	
Variance	0.1975	
Skewness	1.0324	
Kurtosis	2.0659	

cvp

	Percentiles	Outliers
1%	0	0
5%	1	0
10%	1	0
25%	2	0
50%	2	
75%	2	4
90%	2	4
95%	3	5
99%	3	6
Mean	1.9277	
Std. Dev.	0.4267	
Variance	0.1821	
Skewness	1.2225	
Kurtosis	2.4946	

d_pool		
	Percentiles	Outliers
1%	0	0
5%	0	0
10%	0	0
25%	0	0
50%	0	
75%	0	1
90%	1	1
95%	1	1
99%	1	1
Mean	0.2392	
Std. Dev.	0.4267	
Variance	0.1821	
Skewness	1.2225	
Kurtosis	2.4946	

detour		
	Percentiles	Outliers
1%	0	0
5%	53.9	0
10%	258.6	0
25%	736.1	0
50%	1,349.2	
75%	2,025.4	7,242.0
90%	3,182.4	7,244.3
95%	4,116.3	7,319.2
99%	5,758.3	7,435.6
Mean	1,586.5	
Std. Dev.	1,257.3	
Variance	1,581,004	
Skewness	(0.6194)	
Kurtosis	2.664	

dist		
	Percentiles	Outliers
1%	295.28	20
5%	853.02	20
10%	1,377.95	53
25%	2,739.50	53
50%	4,363.52	
75%	6,135.17	12,762.5
90%	8,333.33	12,828.1
95%	9,317.59	13,320.2
99%	11,154.86	16,961.9
Mean	4,631.7	
Std. Dev.	2,556.7	
Variance	6,536,834	
Skewness	0.5463	
Kurtosis	3.0000	

dist_l		
	Percentiles	Outliers
1%	0.3938	0.3776
5%	0.4009	0.3869
10%	0.4054	0.3883
25%	0.4180	0.3885
50%	0.4325	
75%	0.4529	0.6417
90%	0.4854	0.6726
95%	0.5092	0.6726
99%	0.5662	0.7348
Mean	0.4403	
Std. Dev.	0.0354	
Variance	0.0012	
Skewness	2.0276	
Kurtosis	10.199	

park_l	Percentiles	Outliers
1%	0.2800	0.2800
5%	0.2800	0.2800
10%	2.0399	0.2800
25%	3.3199	0.2800
50%	5	
75%	5.789	7.2
90%	7.2	7.2
95%	7.2	7.2
99%	7.2	7.2
Mean	4.4021	
Std. Dev.	1.9153	
Variance	3.6685	
Skewness	(0.619)	
Kurtosis	2.787	

per_sub	Percentiles	Outliers
1%	0	0
5%	0	0
10%	0	0
25%	0	0
50%	15.099	
75%	26.102	46.689
90%	46.689	46.689
95%	46.689	46.689
99%	46.689	46.689
Mean	13.092	
Std. Dev.	14.835	
Variance	0.0220	
Skewness	0.8117	
Kurtosis	2.664	

per_road	Percentiles	Outliers
1%	0	0
5%	0	0
10%	0	0
25%	11.137	0
50%	26.266	
75%	49.829	1
90%	1	1
95%	1	1
99%	1	1
Mean	0.3576	
Std. Dev.	0.3083	
Variance	0.0959	
Skewness	0.8059	
Kurtosis	2.7842	

j_score	Percentiles	Outliers
1%	75.0	75.0
5%	75.0	75.0
10%	79.8	75.0
25%	79.8	75.0
50%	94.1	
75%	97.3	98.1
90%	98.1	98.1
95%	98.1	98.1
99%	98.1	98.1
Mean	89.68	
Std. Dev.	8.560	
Variance	73.27	
Skewness	(0.4276)	
Kurtosis	1.469	

lin_j_l

	Percentiles	Outliers
1%	1,246.7	0
5%	2,165.4	323.08
10%	2,985.6	42651
25%	5,085.3	492.13
50%	7,431.1	
75%	12,450.8	49,475.1
90%	16,535.4	49,967.2
95%	18,438.3	50,164.0
99%	36,056.4	50,754.6
Mean	9,143.22	
Std. Dev.	6,229.48	
Variance	3.88e	
Skewness	2.159	
Kurtosis	11.88	

free_0

	Percentiles	Outliers
1%	47.233	18.113
5%	63.759	22.911
10%	69.210	30.845
25%	79.367	37.994
50%	96.187	
75%	116.545	147.708
90%	129.733	148.373
95%	137.110	148.373
99%	146.369	150.320
Mean	98.272	
Std. Dev.	23.450	
Variance	549.917	
Skewness	0.0463	
Kurtosis	2.2438	

free_l

	Percentiles	Outliers
1%	2,230.9	328.1
5%	4,065.2	524.9
10%	4,790.0	951.4
25%	6,299.2	1,443.6
50%	9,251.9	
75%	13,582.7	21,817.6
90%	16,830.7	22,014.4
95%	18,799.2	22,014.4
99%	21,423.9	22,596.1
Mean	10,206.9	
Std. Dev.	4,674.75	
Variance	2.19e	
Skewness	0.4621	
Kurtosis	2.3237	

free_2

	Percentiles	Outliers
1%	4,977,233	107,639
5%	1.65e	275,556
10%	2.29e	905,244
25%	3.97e	2,083,893
50%	8.56e	
75%	1.84e	4.76e
90%	2.83e	4.85e
95%	3.53e	4.85e
99%	4.59e	5.11e
Mean	1.26e	
Std. Dev.	1.08e	
Variance	1.17e	
Skewness	1.160859	
Kurtosis	3.774972	

rad_air		
	Percentiles	Outliers
1%	3.1203	2.8978
5%	3.6811	2.9168
10%	4.3555	2.9874
25%	13.0234	2.9959
50%	13.6383	
75%	14.3144	19.8271
90%	17.7668	19.8679
95%	19.4181	19.8786
99%	19.7315	20.0369
Mean	12.853	
Std. Dev.	4.2244	
Variance	17.845	
Skewness	(0.8423)	
Kurtosis	3.2756	

rad_cbd		
	Percentiles	Outliers
1%	5.03	2.29
5%	5.32	2.29
10%	5.85	2.29
25%	7.24	2.37
50%	12.44	
75%	15.68	17.53
90%	16.31	17.53
95%	16.85	17.59
99%	17.37	17.60
Mean	11.4156	
Std. Dev.	4.23633	
Variance	17.9465	
Skewness	(0.15249)	
Kurtosis	1.45446	

4

The park, like the neighborhood, is as much a cultural construct as an actual, functioning entity. Both terms have historical and cultural associations that lend them much of their power and resonance. One can be firmly convinced of the merits of neighborhood, for this reason, without ever having lived in a place that could qualify as such. Any discussion of the idea of the park, no matter how thoroughly couched in the language of economics or of statistics, will engage a series of assumptions and associations. Many of these date to the beginning of the twentieth century, corresponding roughly to the emergence of an understanding of parks as instruments of social reform.

The use of historical references introduces both benefits and risks. The neighborhood plan or park proposal of any era carries with it assumptions about family size and structure, social organization, travel patterns, and community aspirations that are peculiar to its time and place. The idea that neighborhood services - schools, parks, shops, churches, and the like - would be within walking distance of a common group of residents, for example, was predicated on a certain level of population density relative to the drawing radius of each of those services. This assumption was critical to the neighborhood proposals of Perry or Adams, for example.

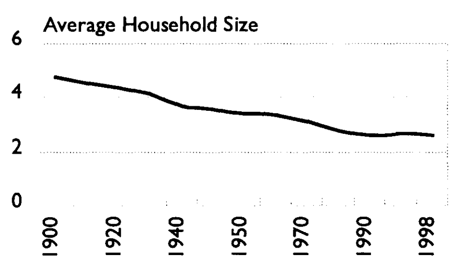
However, over the twentieth century the average U.S. household size declined from 4.76 people to 2.61.[1] (Illus. 4.1) New developments, even built to the unit density standards of traditional neighborhoods, will have radically different population densities from those that justified historical proposals. This smaller household size affects the street life and character of neighborhoods. At the same time, house size has risen steadily throughout the twentieth century, further constraining population densities. It becomes more difficult to design active, lively public amenities because there are simply fewer people within walking distance to use them.[2]

The thesis incorporates historical precedents and references, but tries to do so in a way that acknowledges their potential biases or that focuses narrowly on specific characteristics of the precedent. Research, based on existing, conventional suburbs, is used to analyze and evaluate the likely performance of historical neighborhood proposals, and thereby to draw conclusions about the contemporary viability of those plans.

The Chicago Competition

In 1913 the City Club of Chicago sponsored a competition for the design of a quarter section of a generic Chicago suburb. The 2640 foot-square plot of land, conventionally subdivided, would have included thirty-two blocks, each measuring 600 feet by 270 feet. Using the area's typical 25-foot lots, the quarter section would provide 1536 units of single-family housing, at a gross density of 9.6 units per acre. (This gross figure excludes any park spaces, commercial or civic buildings, churches, schools, playgrounds, etc.) The site would have 74% lot coverage, with a 3,375 s.f. lot supporting 1,162 s.f. of public right-of-way. It would look, in plan or in execution, almost startlingly monotonous. (Illus. 4.2)

The thirty-nine entrants, twenty of whose proposals were later published in a book about the competition,[3] were charged with integrating commercial facilities, schools, churches and different residence types to produce a coherent unit. (Most submissions reasonably treated the quarter section as a neighborhood, though this was not specified in the program.) Proposals were limited to

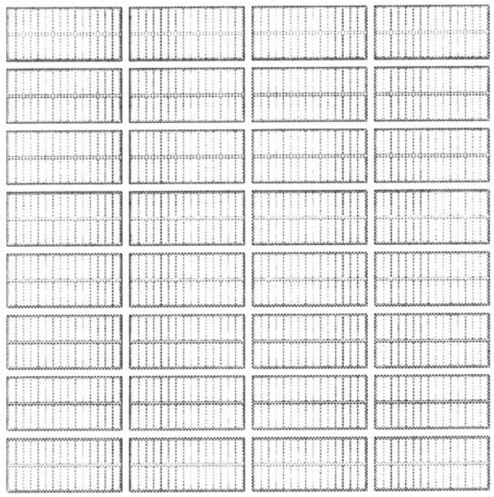


Illus. 4.1
Change in U.S. household size over time

[1] *U.S. Census Bureau, Statistical Abstract of the United States*, 1999, p. 873.

[2] In a 1922 article, Henry Hubbard was comfortable with occupancy estimates of 200 people per acre for urban land surrounding a park or playground. By contrast, a modern subdivision might reasonably see occupancy of 10 to 15 per acre surrounding the park. The role of recreation spaces as a safety valve for the seething masses, then, has diminished greatly.

[3] See Yeoman, 1916.

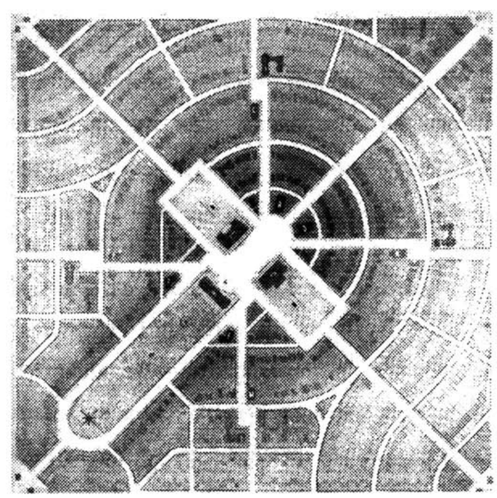


Illus. 4.2
The generic, speculative gridiron rejected by the City Club of Chicago.

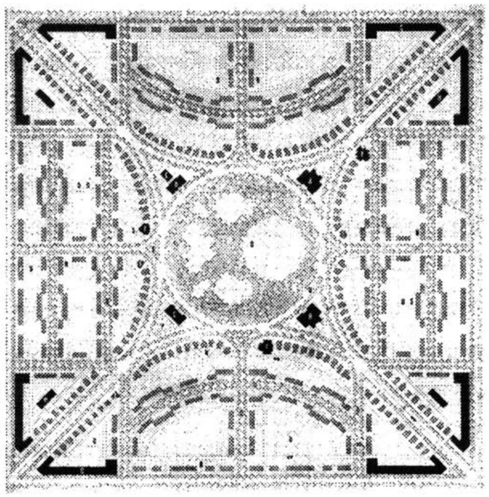
1,280 units of housing, at a not unreasonable density of 8 units per acre when public facilities were included. Typical lot sizes, public land coverage, utility costs, and the proportions of land devoted to sidewalks and roads were all to be calculated and included in the proposal.

The entries displayed a full range of attitudes. (Illus. 4.3-5) Street plans included modified grids, radial plans, picturesque streetscapes, and *beaux-arts* assemblages. Diagonal boulevards, too, were a popular organizing strategy. Combined with biaxially symmetrical layouts, several plans resemble little so much as tile patterns. Many of the more geometric plans, though cunningly integrated into the surrounding gridiron, would be as oppressive as the gridiron they replaced if extended across a landscape. Others, particularly the naturalistic plans, placed their roads with an almost aggressive disregard for the needs of traffic from the surrounding community. While maintaining an open network, this indifference toward surrounding developments presaged the future move toward closed and dendritic street systems.

One plan proposed grouping homes around landscaped courts, and another relied on cul-de-sacs. The latter was castigated by one juror for perpetuating the "evils of the blind alley." One plan paved the alleys for regular vehicular access and left the main streets planted in grass. Many used formal groupings of public buildings, and most placed com-



Illus. 4.3
Competitive Plan by William Schuchardt
1913 City Club of Chicago Competition

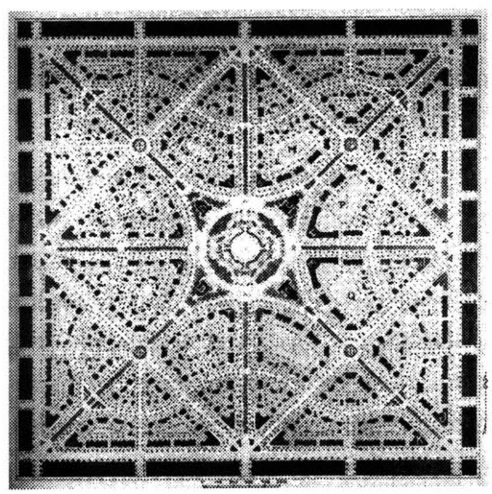


Illus. 4.4
Competitive Plan by Phelps Wyman
1913 City Club of Chicago Competition

mercial establishments along the boundaries of the quarter section, abutting the busy thoroughfares.

The plans are interesting and useful guides. Concerned with general solutions to a general problem, the program avoided topographical conditions or other site conditions that might shape the proposals too strongly. (As it was, the one site condition supplied - the location of streetcar lines going to the city - exerted a strong influence on several plans.) In many fast growing U.S. housing markets, a generic site is still descriptive of actual conditions. The program engages issues both of possible repetition of the design and of the design's isolated placement within a conventional context. While large enough to demand consideration of public amenities, the quarter section is small enough to engage issues of externalities with neighboring areas.

In its insistence on precise analytical statistics, the justifications of its entrants, and the content of the critiques, the competition was firmly in the tradition of 'scientific' planning. Progressive writers had grasped early the effect of planning on real estate values, justifying progressive or Utopian proposals in economic terms. Rational planning would create an attractive neighborhood, and thereby attract the residents that assured its success. Equally, it would reduce inefficiencies in design and construction, concentrating scarce resources to maximum effect.



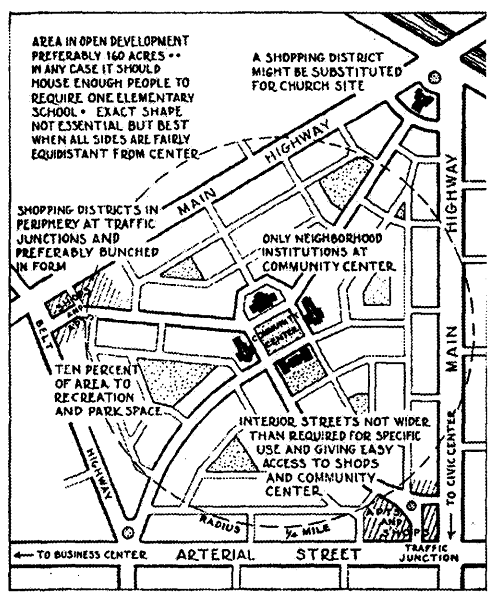
Illus. 4.5
Competitive Plan by Louis Boynton for the 1913 City Club of Chicago Competition. Replicated, it numbs.

The potential downsides of this success were also apparent to some. Neighborhoods that were too attractive might result in higher property values, displacing the residents for whom the neighborhood had been rationally, optimally designed. This concern about the impact of filtration in the housing supply led some progressives to advocate deed covenants on newly built neighborhoods. Whitten and Adams (1931) indeed thought it essential that lot values not appreciate. "By planning for permanence rather than convertibility and by permanently restricting the land by deed and by zoning to the type and intensity of use for which it is devoted and is most suitable, it should be possible to alter the present tendency to change to a more and more intensive use." While progressive in its aspirations, the idealized neighborhood unit, once completed, was to be a bulwark against further change.

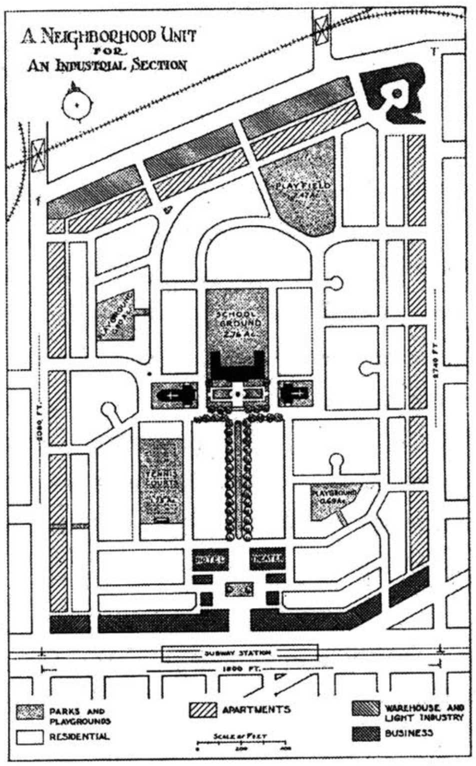
Many of the approaches pursued by these plans later crystallized in Perry's classic neighborhood diagram for the New York Regional Plan. (Illus. 4.6) A civic center, with churches and a school, formed the heart of the community. Parks were placed equidistant from the civic center and the neighborhood's edges, which were ringed with commercial properties fronting onto arterials. This simultaneous centralizing and decentralizing tendency distinguished the neighborhood from the village or town.

A similar plan by Perry, published in *The American City* in 1929, illustrates these problems. (Illus. 4.7) In a 100-acre site, Perry proposes two churches, a theater, a hotel, office and industrial space, and 8.5 acres of school ground and park space. To provide demand for this space, he projects occupancy of 8,800, an astonishing density of 88 persons per gross developed acre. At conventional density standards, his proposed services, and hence the viability of his diagram, are not realistic.

As Adams and others have noted, the effectiveness of a neighborhood plan depends on its context. Individual devel-



Illus. 4.6
Neighborhood Unit Diagram from the 1929 New York Regional Plan



A DIAGRAM SUGGESTING A POSSIBLE TREATMENT OF A 100-ACRE TRACT SOMEWHAT CENTRALLY LOCATED
Designed for single, row and multiple housing, accommodating 8,800 people. Note main business district at transportation point

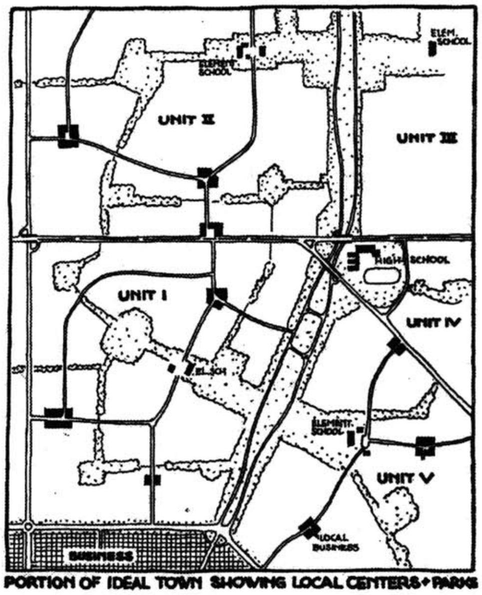
Illus. 4.7
A 1929 neighborhood unit plan by Perry.

opers have an incentive to place facilities with disamenities near the neighborhood edge, while concentrating purely desirable facilities at the core. Extrapolation of this individual incentive produces a series of closed communities ringed by unattractive arterials.

In the Chicago competition, at least one entrant, the plan by Louis Boynton (Illus. 4.5), did show the effect of replication of the plan. [4] Most others, however, took pain to contrast their plans with those of generic surroundings. As a result, few of the surrounding neighborhood streets drawn by competition entrants line up with those of the proposed neighborhoods. The resulting neighborhood plans, even naturalistic ones, verge on the monumental in their celebration of the neighborhood as a freestanding entity.

The monotony caused by endless repetition of an idealized plan is unlikely in modern cities, given the fragmentation of ownership of property. Viable neighborhood plans, however, are sustainable and extendable; that is, they absorb roughly the amount of disamenity they produce. With his plans and writings, for example, Adams presented a network diagram, showing how the basic strategy would replicate across a landscape. (Illus. 4.8) The diagram is valuable not as a proposal for a city but as a means of evaluating the sustainability of individual proposals, and thereby to evaluate their responsibility.

[4] William F. Faville, F.A.I.A, writing in the publication book, noted: "The geometrical type based on a unit capable of endless repetition, as suggested by several of the plans and distinct from the gridiron type, has al of the plans and distinct from the gridiron type, has been carefully developed by theorists in the past, but not often followed in construction. The rigidity and monotony of this one type of solution has not been met with the approval of city builders and happily h as been left behind."



Illus. 4.8
Portion of Ideal Town Showing Local Centers and Parks. From *The Design of Residential Areas*, by Thomas Adams. The plan illustrates how Adams' residential neighborhoods would form a network of linked arterials and open space.

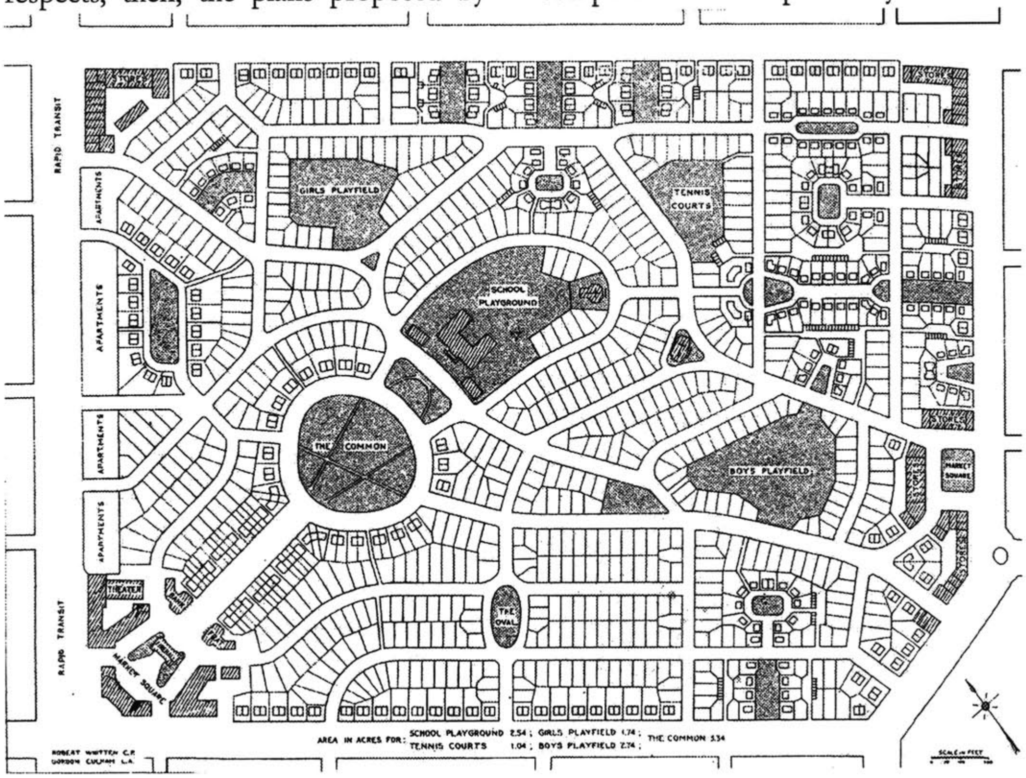
Many neighborhood plans, even from 1916, presaged the adoption of many suburban patterns now considered standard. The proposals utilized cul-de-sacs and fragmented street grids extensively. Despite this, the influence of such idealized neighborhood plans on postwar urban growth patterns has been slight. One reason for this may be that the typical neighborhood unit plan includes extensive open spaces, parks, and community facilities. (Illus. 4.9) A private developer needs to recoup not just the considerable cost of those amenities, but a premium that compensated for the added market and construction risk those neighborhood plans entail. That is only possible if land ownership was consolidated at a very large scale. Otherwise, a comparatively small number of buildable parcels must absorb the entire cost of the amenities, while adjacent homes built by other developers will receive the benefits.

Semi-public amenities, privately provided in an area with fragmented ownership, create a free-rider problem. Individual landowners cannot support the cost of the amenities in light of their expected return. Even if developers consolidate large blocks of land, the absence of economically viable examples of comprehensive neighborhood planning increases the perceived risk. This explains in part why contemporary, conventional neighborhoods contain few amenities. That amenities are costly is not the answer, because those amenities provide benefits as well. However, the benefits of those amenities are difficult to measure reliably in advance.

An additional issue is why, when amenities are included, street plans are so seldom designed to maximize their value. Partly, this reflects regulatory restrictions. The incorporation into municipal planning codes of street hierarchies based on modernist theory has radically restricted the feasibility of other plans. Using a traditional street grid, with traditional road standards, is almost impossible without extensive, costly negotiation with city officials.

Neighborhoods with hierarchically planned street grids impose costs on traditional neighborhoods, and these in turn further limit the use of traditional street planning. Excluding through-traffic themselves, their residents can nonetheless use surrounding neighborhood roads as through-streets. In most respects, then, the plans proposed by early reformers would work best surrounded by a conventional gridiron plan. Fundamentally unsustainable, they generate more negative externalities for surrounding neighborhoods than they themselves could accommodate without sharply reducing the promised quality of life. (Illus. 4.10) Once begun, then, the hierarchical street system will tend to drive out conventional street grids in new development by imposing additional costs on conventional street grids.

The simplest plan detail that might compensate for the proximity value lost



Illus. 4.9
Neighborhood unit by Whitten and Culham, published in the New York Regional Plan

due to irregular street plan is the pass-through, a publicly accessible pedestrian walkway built between the side yards of adjacent houses. Abutting residents dislike the lack of side yard privacy, however, and so erect high wooden privacy fences along the path. Now in deep shadow and invisible to the surrounding neighborhood, the paths pose a safety hazard, and are commonly prohibited.

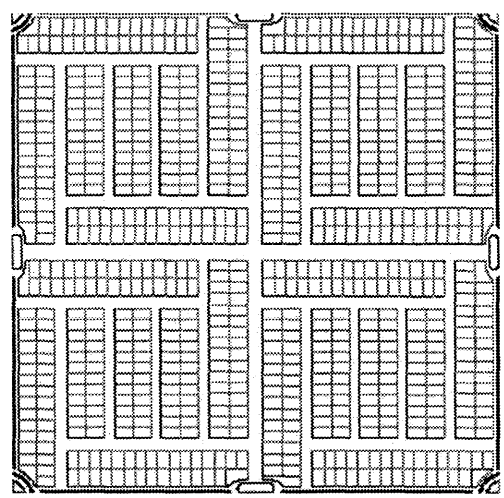
Other elements, like narrow streets and alleys, that might again mitigate the effect of conventional planning standards, are prohibited by traffic engineering requirements or by perceived life safety risks linked to the comfortable turning radius of fire trucks.

Every deviation from conventional standards, then, imposes substantial costs and financial risks to the developer, designer, and city. Understanding which deviations will have the greatest impact on the success of the neighborhood, and quantifying what that effect might be, is an essential part of the cost-benefit analysis needed for new projects. In the case of parks, this particularly means understanding what street and neighborhood plan characteristics have the greatest effect on proximity premiums.

Comparative plans

The research looked at several neighborhood plans to estimate the land rent premiums associated with their park space. The graphical measurements of these effects are basic. Housing characteristics were ignored, as are other spatial characteristics or proximity measurements other than basic distance. Several of the plans are not complete proposals, in that they are intended to illustrate and explore only one aspect of a street plan. The plans then are not a typology of possible design strategies, but explorations of how certain aspects of neighborhood plans determine amenity value.

The first plan, Illus. 4.11, proposes a basic gridiron neighborhood with a modified Harrisonburg Square park. The plan takes no account of lot diversity or commercial uses, and seeks simply to



Illus. 4.10
Wright's proposal of 1930. Arterials border the neighborhood on all sides.

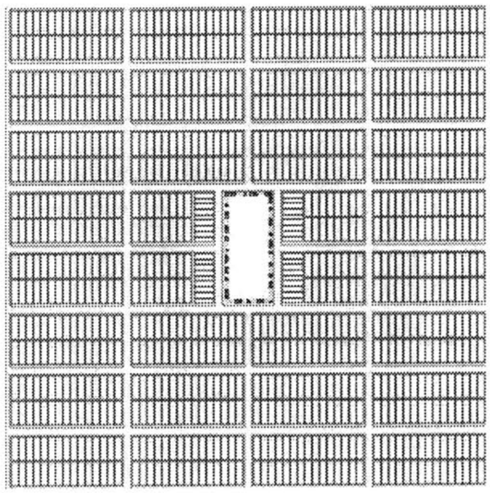
explore the impact of a park in a gridiron plan.

The second plan, Illus. 4.12, is liberally based on pinwheel design proposed by Henry Wright in 1930 (Illus. 4.10), to which a central park has been added. The goal here is to explore the impact of an indirect street grid on proximity premiums.

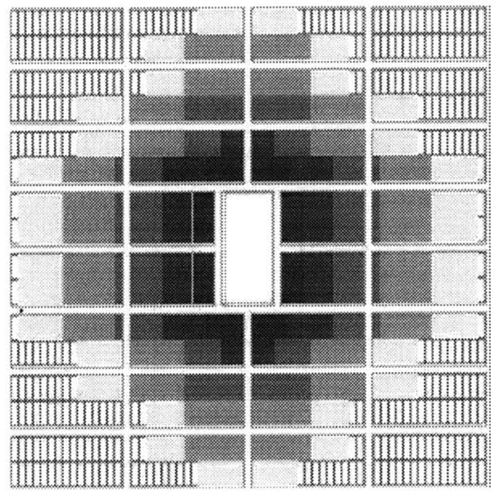
Two of the plans are based on historical examples. The first of these entries, Illus. 4.13, proposed by Charles Bennett in 1930, is a single large park at the center and green streets leading out along the cardinal points. The plan has a porous block structure, and includes both a consolidated central park and green corridors. The other historical plan, Illus. 4.14, from the City Club of Chicago competition, used numerous cul-de-sacs, then still called 'dead-ends.' The plan illustrates how highly fragmented street grids can dissipate location value unless pedestrian paths are provided.

The fifth plan, Illus. 4.15 intentionally blurs the distinction between a village plan and a neighborhood plan. A central retail core anchors the neighborhood, with small lots clustered around. Both the lot width and depth increase toward the perimeter of the site, ending in a ring of parks, boulevards, and school facilities. Proximity to the center of the neighborhood here is negatively correlated with proximity to parks.

The final plan, Illus. 4.16, incorporated some of the principles discussed elsewhere in the work. Parks are decentralized, and the distorted street grid creates a range of lot sizes.



Street Plan



Distance-based Gradient Plan

Plan Advantages

- Contains rent gradient within parcel
- Reduces perimeter infrastructure costs of park
- Simple wayfinding
- Optimizes value of park to residential property

Plan Disadvantages

- Underserved by parks
- No park variety
- No variety of lots
- Difficult to phase
- No provision for future commercial space
- Monotonous

Plan Statistics

Residential Area	5,184,000	74.4%
Retail	0	0%
Parks	0	0%
Right of Way	1,785,600	25.6%
Total Area	*6,969,600*	*100.0%*

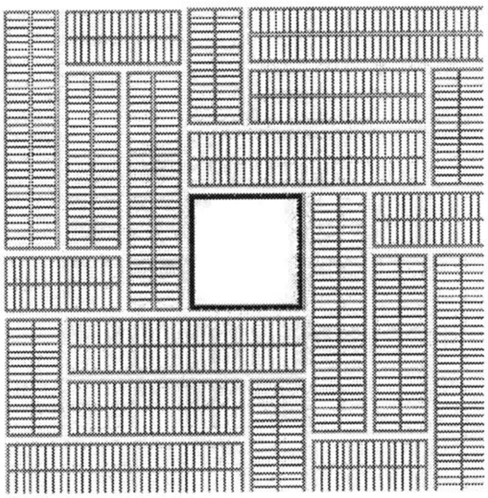
Residential Lot Sizes

40x128	5120 sf	960

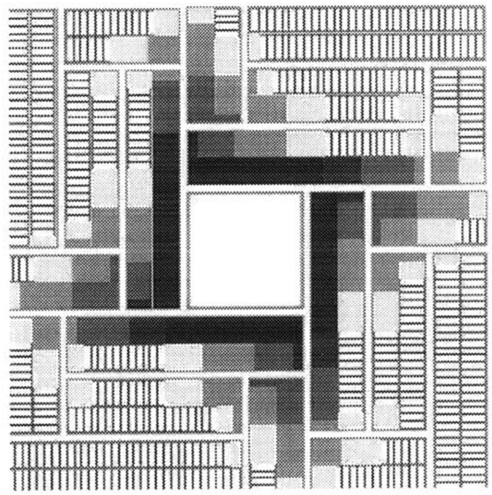
Premium Effect on Lots

	percent receiving given premium	
Premium	Lots	Land
20.0%	*6.1%*	*3.2%*
10.0%	*7.4%*	*2.9%*
5.0%	*12.2%*	*8.3%*
2.5%	*22.2%*	*15.1%*
1.0%	*20.9%*	*13.6%*

Illus. 4.11



Street Plan



Distance-based Gradient Plan

Plan Advantages

- Contains rent gradient within parcel
- Reduces perimeter infrastructure costs of park
- Spiral street pattern eliminates four-way intersections
- Long blocks reduce infrastructure cost

Plan Disadvantages

- Underserved by parks
- No park variety
- Spiral block plan is inefficient with respect to travel time
- No variety of lots
- Difficult to phase
- Blocks are long and monotonous
- Park may be inefficiently large / generate diseconomies

Illus. 4.12

Plan Statistics

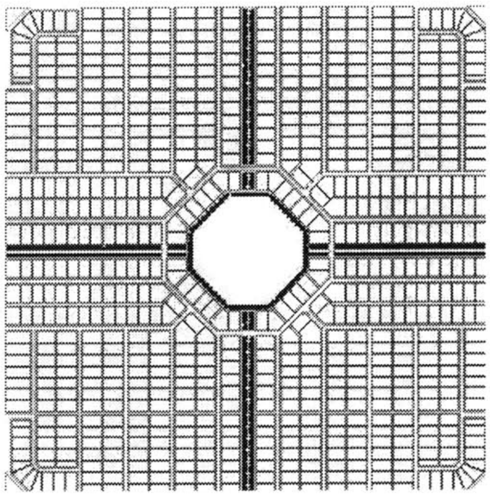
Residential Area	4,784,000	68.6%
Retail	0	0%
Parks	360,000	5.2%
Right of Way	1,825,600	26.2%
Total Area	*6,969,600*	*100.0%*

Residential Lot Sizes

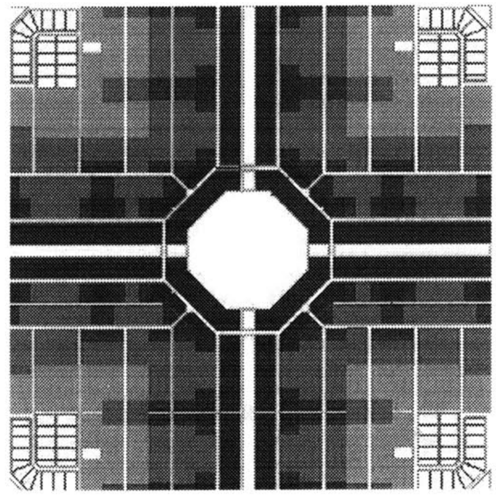
40x130	5200 sf	920

Premium Effect on Lots

	percent receiving given premium	
Premium	Lots	Land
20.0%	*7.7%*	*5.4%*
10.0%	*3.4%*	*1.9%*
5.0%	*8.1%*	*5.6%*
2.5%	*12.8%*	*8.9%*
1.0%	*14.0%*	*9.9%*



Street Plan



Distance-based Gradient Plan

Plan Advantages

- Highly efficient for maximizing value of parks
- Permits network of green spaces
- Little diversity of green space
- Very porous block structure
- Some diversity of lot sizes
- Provision for commercial space

Plan Disadvantages

- Monotony of boulevards may reduce premium
- Commercial space is distributed equally to four corners
- Disorienting, Non-orthogonal core
- Monotonous
- Angled roads create corner parcels w/ small backyards
- Abutting houses minimize park benefits

Illus. 4.13

Plan Statistics

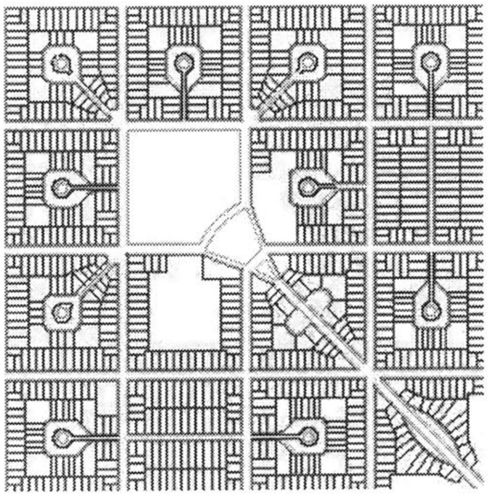
Residential Area	4,143,800	59.5%
Retail	228,000	3.3%
Parks	512,000	7.35%
Right of Way	2,313,800	33.2%
Total Area	*6,969,600*	*100.0%*

Residential Lot Sizes

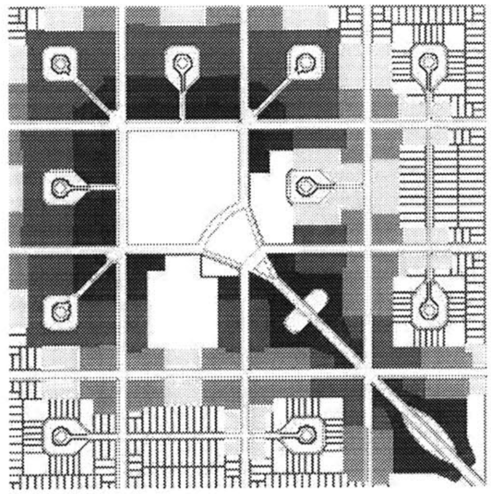
60x100	6000 sf	596
60x130	7800 sf	28
80x100	8000 sf	12
Irreg.	9150 sf	12
Irreg.	5100 sf	12
Irreg.	5150 sf	16

Premium Effect on Lots

Premium	*percent receiving given premium* Lots	Land
20.0%	*26.0%*	*15.9%*
10.0%	*13.0%*	*7.9%*
5.0%	*33.7%*	*21.9%*
2.5%	*21.9%*	*11.4%*
1.0%	*5.3%*	*3.4%*



Street Plan



Distance-based Gradient Plan

Plan Advantages

- Diversity of lot sizes
- Diverse green space
- Many cul-de-sac lots
- Provision for commercial space
- Provision for institutional space
- Plentiful through-streets

Plan Disadvantages

- Many awkward, difficult lots
- No alleys
- Non-porous block structure
- Many awkward intersections
- Diagonal streets can be disorienting
- Angled roads create corner parcels w/ small backyards
- Street grid dissipates value of proximity

Illus. 4.14

Plan Statistics

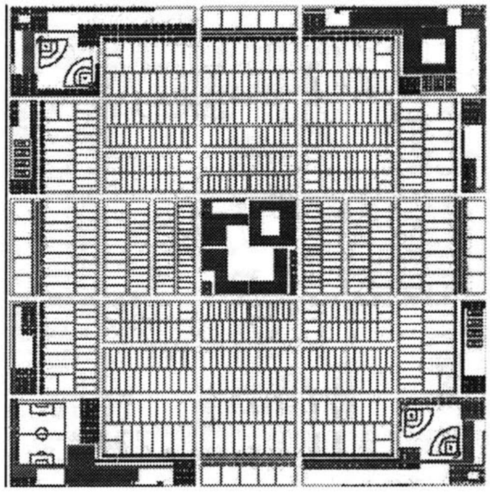
Residential Area	4,342,916	62.3%
Retail	131,600	1.9%
Parks	699,340	10.0%
Right of Way	1,927,344	27.8%
Total Area	*6,969,600*	*100.0%*

Residential Lot Sizes

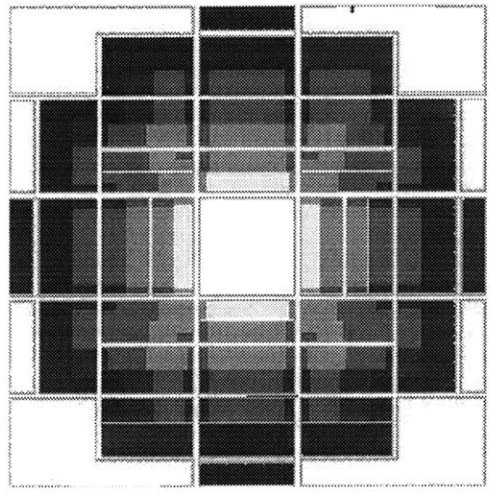
32x100	2400 sf	100
40x60	2400 sf	60
40x80	3200 sf	139
40x100	4000 sf	344
40x105	4200 sf	33
40x120	4800 sf	88
40x140	5600 sf	88
Irreg.	Varies	151
Total		*1003*

Premium Effect on Lots

	percent receiving given premium	
Premium	Lots	Land
20.0%	*8.0%*	*5.3%*
10.0%	*8.9%*	*4.8%*
5.0%	*22.8%*	*16.0%*
2.5%	*17.2%*	*9.5%*
1.0%	*13.3%*	*8.1%*



Street Plan



Distance-based Gradient Plan

Plan Advantages

- Diversity of lot sizes
- Diverse green space
- Many cul-de-sac lots
- Provision for commercial space
- Provision for institutional space
- Plentiful through-streets

Plan Disadvantages

- Many awkward, difficult lots
- No alleys
- Non-porous block structure
- Many awkward intersections
- Diagonal streets can be disorienting
- Angled roads create corner parcels w/ small backyards
- Street grid dissipates value of proximity

Illus. 4.15

Plan Statistics

Residential Area	4,342,916	62.3%
Retail	131,600	1.9%
Parks	699,340	10.0%
Right of Way	1,927,344	27.8%
Total Area	*6,969,600*	*100.0%*

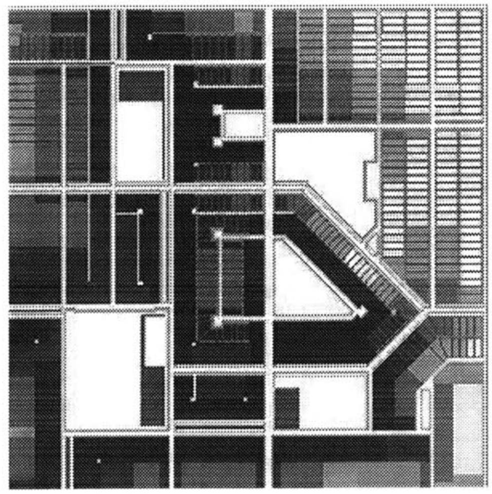
Residential Lot Sizes

32x100	2400 sf	100
40x60	2400 sf	60
40x80	3200 sf	139
40x100	4000 sf	344
40x105	4200 sf	33
40x120	4800 sf	88
40x140	5600 sf	88
Irreg.	Varies	151
Total		*1003*

Premium Effect on Lots

	percent receiving given premium	
Premium	Lots	Land
20.0%	*17.0%*	*26.7%*
10.0%	*8.9%*	*5.8%*
5.0%	*32.8%*	*12.4%*
2.5%	*17.9%*	*7.4%*
1.0%	*6.0%*	*2.3%*

Street Plan



Distance-based Gradient Plan

Plan Advantages

- Diversity of lot sizes with optimized proportions
- Permits network of green spaces
- Variety of parks and park activities
- Plentiful through-streets
- Many awkward intersections, lots
- Flexible plan accommodates site conditions
- Decentralized system of parks maximizes lot frontage

Plan Disadvantages

- Commercial core separated from perimter arterials
- Angled roads may be disorienting
- Decentralized system of parks maximizes infrastructure costs
- Many four-way intersections

Illus. 4.16

Plan Statistics

Residential Area	4,051,700	58.1%
Retail	201,600	2.9%
Parks	899,100	12.9%
Right of Way	1,817,100	26.1%
Total Area	*6,969,600*	*100.0%*

Residential Lot Sizes

30x85	2550 sf	132
35x90	3150 sf	31
35x110	3850 sf	188
40x110	4400 sf	346
40x145	5800 sf	6
45x125	5625 sf	26
45x135	6075 sf	101
55x155	8525 sf	6
80x150	12000 sf	8
Irreg.	Varies	46
Total		*881*

Premium Effect on Lots

	percent receiving given premium	
Premium	Lots	Land
20.0%	*30.3%*	*17.6%*
10.0%	*18.8%*	*15.0%*
5.0%	*19.3%*	*12.2%*
2.5%	*11.8%*	*8.0%*
1.0%	*7.2%*	*5.2%*

Plan Analysis

Each of the plans represents not just a particular formal relationship of the park to the surrounding neighborhood, but a series of implicit assumptions about the design of a neighborhood and about the behavior of park value. These differences principally involve extrapolation from conclusions or concepts that are implicit in the research to plans whose attributes are different from those of neighborhoods found in the data set. They will suggest in turn qualifications of the principal research results and areas for further exploration.

Lot size and proportions

Early reformers identified narrow, deep lots as the source of innumerable social ills. Olmsted, for example, believed such lots encouraged squalor, the accretion of rear units, and a lack of adequate light and ventilation in the middle rooms of deep houses. The aesthetic impact was thought to be just as damaging as the social impact. Narrow lots, like the 25-foot wide lots common in Chicago at the turn-of-the-century, were considered numbingly monotonous.

Others noted the specific correlation between the width of lots and the architectural form of houses: "The front yard which is wider than deep makes it appear wider than it really is; the deep narrow yard makes it look narrower." [5] The human field of vision, which emphasizes the horizontal, imposed additional constraints on the appearance of houses on lots of different shapes.

Despite concerns about the aesthetics of such lots, they had obvious benefits. Olmsted treated this discrepancy in the optimal proportion of lots with functionalist resignation, noting that, due to the infrastructure associated with frontage, a disproportionately large decrease in depth accompanied each increase in width. "Much as I loathe the tiresome familiar rows of detached houses squeezed onto 30-foot and 40-foot lots, I should not hesitate a moment to give up the difference between 50 feet and 40 feet of width for the sake of the extra 42 feet of depth."[6]

Despite his concerns about the use of narrower lots at high densities, Olmsted saw their aesthetic benefits in the context of garden suburbs. Narrower, deeper lots permitted houses to be set in further from the street without sacrificing entirely the back yard. "We cannot judiciously attempt to control the form of the houses which men shall build, we can only, at most, take care that if they build very ugly and inappropriate houses, they shall not be allowed to force them

[5] Bottomley, p. 6.

[6] Olmsted (1915), p. 162.

disagreeably upon our attention when we desire to pass along the road upon which they stand. We can require that no house shall be built within a certain number of feet of the highway, and we can insist that each house-holder shall maintain one or two living trees between his house and his highway-line."[7] As lots became narrower, houses tended to become taller, and expansive setbacks became more important to the appearance of the house itself. Tall homes "need deeper foregrounds than low buildings. Enough space is needed in front of any good building to present it to persons in passing as one architectural unit."[8]

Once the red herring of nineteenth century tenement lots is dispatched, then, the benefits of narrow lots become clear. Preferred by residents because they provide more usable yard space, and by developers because they minimize infrastructure costs, the shape of a narrower lot, and the deeper setbacks it makes possible, permits the placement of houses to best effect.

Premium Dilution

The rent premiums derived in the research may in part reflect a scarcity of lots accessible to parks. Most of the Dallas region is, by the standards of twentieth century reformers, under-served by open space. Of the park space that does exist, much of it is either inaccessible to pedestrians or concentrated in large, intermittently located parcels. If observed prices do reflect a scarcity premium, extrapolation of the research to multiple-park systems will overestimate the net value created by those parks.

Preservation of the proximity premiums in centralized-park neighborhoods in a distributed-park neighborhood will depend on the differentiation of the functions of each park and on the addition of additional functions possible only in a distributed-park model.

Providing each park in a distributed system with functions that appeal to different household types will, as discussed in chapter two, differentiate the proximity gradients of the parks, and prevent those parks from acting as economic substitutes for one another. Proximity premiums associated with parks filling different functions will be better able to coexist in the sale price of individual properties within their drawing radius.

Distributed parks have other positive effects on a neighborhood. The potential to use park systems to provide stormwater drainage systems, jogging paths or wildlife corridors was discussed in chapter one. Each of these is a benefit that cannot be provided by a large,

[12] Olmsted, Vaux & Co. (1868)

[13] Bottomley, p. 7

consolidated park. The benefits of that will serve then to counteract any dilution in value caused by the declining marginal utility of additional parks.

A network of small parks can also provide symbolic benefits that counteract the dilution of functional or status benefits when multiple parks are present. A suburb with a park somewhere in it is very different from a garden suburb, the garden suburb relying for its effectiveness on the perceived abundance of nature. As Olmsted wrote, "(the) main artificial requirements of a suburb the, are good roads and walks, pleasant to the eye within themselves, and having at intervals pleasant openings and outlooks, with suggestions of refined domestic life, secluded, but not far removed from the life of the community."[9] A network of parks may better convey this idea about the landscape and the neighborhood, and in that way increase the value that residents place on its design.

Distributed parks increase the total number of lots within range of the park relative to a consolidated park of equivalent area, and thereby offer a larger potential total rent premium. In addition, distributed parks offer benefits to the developer, in terms of project phasing and sales velocity, that will tend to make the of distributed parks more attractive in any event. The difficulty of building small parks under most conventional municipal standards, however, will act as a deterrent.

In the event that any of these premiums or dilutions hold, the distances measured on the comparative plans will not correspond precisely to the distance premium specification or coefficients produced in the research. The value of each park will decline as more parks are added to the neighborhood. Alternately, the assemblage of small parks in close proximity will begin to serve additional needs not met by the large, isolated parks in the study sample. The latter is the more likely outcome for the reasons discussed, which in turn supports a neighborhood model of small, distributed parks. Even if so, however, the particular functions that underlie the values of parks in a distributed park neighborhood will differ from those identified in research on multiple-park models.

Many neighborhoods proposed centralized civic areas, often separate from the retail cores. The civic center included churches, meeting halls, and one or more schools. In this respect they resemble Perry's diagram. In addition to the problem of the drawing radius needed to support such a center, civic centers

[9] Olmsted, Vaux & Co. (1868)

produce at best symbolic agglomerative economies. Indeed, unless the proximity benefits of civic amenities are entirely independent of one another, concentration of those facilities may sacrifice potential proximity benefits for the sake of that symbolism. In any event, the shopping area is probably a more appropriate, functional center for a diverse neighborhood than an elementary school used by only some of the families or the church of an individual denomination.

Park visibility

Parks fill symbolic and passive roles as well as active ones, and therefore the visibility of a park to a community can be important in addition to its practical accessibility. A park situated along major travel routes will be more readily perceived than less accessible neighbors, and plays a larger role in signalling neighborhood 'quality'. The park provides pleasure to people travelling by it, both because of its beauty and because of its symbolism as a 'park.' A park in a highly dendritic system - especially if located on an access road in the system - will have less visibility and hence less symbolic or visual value. The research supports this argument in a simplified form.

Measuring the true visibility of the park to residents requires assumptions about the direction of the central business district, freeway, and other major destinations. All of these, by affecting travel patterns, will affect the frequency with which parks are passed.

Alternately, a gated community, or any neighborhood with a non-porous perimeter, may concentrate traffic patterns in predictable ways. In that case, the entrances to theneighborhood will constitute the focus for travel, and parks can be located to acknowledge those traffic patterns. Arterials are likely to border the land developed by any one company or individual, and therefore to divide in half the rent premiums accruing to the actual builder of the park. Isolated neighborhoods, which channel traffic onto a few exit roads, may have an advantage over porous neighborhoods in this respect.

Park area and lot size

A small pocket park, which might be only one half acre in size, offers few if any functional benefits in a neighborhood of one half acre parcels. Other benefits - community, ecology, symbolism - will need to be the principal justifications for the park. Most of the study parks, and all of those in the comparative plans, are large enough that back yards are unlikely to act as total substitutes for the functional benefits of the parks. The complete elimination of a proximity premium for the functional attributes of a park in the comparative plans based on its size is unlikely. For this reason, however, large parks, which can offer specialized facilities, will suffer less dilution of functional value than small parks as lot size increases.

Parks of any size will be valued more highly as a percent of total property sale price by owners of small lots. This effect is more pronounced when calculated on the basis of a premium per square foot of development parcel. As density rises, more parcels will be within walking distance of the park, and each of those parcels, being smaller, will value the park more as a percent of home value. Higher densities, holding the value of the physical atrributes of the houses constant, will produce a higher total land rent premium.

One possible exception to the rule favoring density could be when the park fills needs that are tied explicitly to the lack of density. In a naturalistically planned garden suburb, for example, which stresses closeness to a romantic idea of nature, open space and parks may strengthen that illusion and thereby increase disproportionately the value of property in that neighborhood.

[10] Whitten and Adams (1931) define the improvement ratio as the relationship between the perimeter of the block, as measured along the center line of the right of way, to the sum of the widths of the lots in the block.

Infrastructure costs

The research findings equate pedestrian paths with traditional roads or thoroughfares, thereby introducing a bias in favor of street systems with pedestrian through-ways. These paths require less buildable land and less infrastructure than conventional access roads but provide, according to the model, the same benefits.

A full analysis of development cost would, if it excluded assessments of traffic and vehicle-miles travelled, introduce further biases against the added infrastructure costs represented by cross streets. Writing in 1928, the British town planner Barry Parker argued that, "(w)e should never construct any short cross roads connecting main roads one with another, because such cross roads never pay. But traffic, and other requirements make cross roads necessary, so we introduce them and accept the loss entailed thereby." The improvement ratio [10] carries, then, no obvious solution. A longer block is always preferable, and an infinitely long block is ideal. Parker correctly notes the difficulty this implies for through-traffic.

The desire to minimize infrastructure costs results in extreme solutions like the 1300 foot block sometimes recommended. [11] Whitten and Adams write, "With the general use of the motor vehicle, the considerations that led to the acceptance of the 600-foot block as suitable in residential sections are changed. The 800- or even the 1200-foot block is not unduly inconvenient for the motor vehicle. For the pedestrian 1200 feet is certainly excessive unless a footpath is provided about midway across the block."[12]

While Parker may not have supported the extreme implications of this strategy, he clearly supported its general intent. He wrote: "The acid-test of the financial efficiency of plans for housing schemes is the length of road per house. The total lengths of roads of the several widths employed in a scheme, should be divided by the total number of houses in that scheme, and when the length of road per house has been thus ascertained, it should be compared with the length of road per house provided in other schemes and particularly with the length of road per house, provided by alternative "lay-outs" for the scheme in question." [13]

Of course, in no way is the acid test for the financial efficiency of a project actually the cost of the roads that service it. Calculations of efficiency, the ratio of benefits to cost, require consideration of both. The absence of the former produces infrastructure-minimizing solutions like the hexagonal block whose popularity in theoretical writings has been documented by Ben-Joseph and Gordon (2000), or the extensive use of cul-de-sacs.

It is a widely held belief, supported by some research, that cul-de-sac lots sell at a premium relative to those not on a cul-de-sac. [14] However, cul-de-sacs reduce the number of through streets in an area and thereby concentrate through-traffic on remaining streets. Heavy traffic resulting from this concentration may lower the value of lots on collector or subcollector roads. Apparent premiums for cul-de-sac lots then reflect in part a relative preference for such lots in the context of a dendritic street system rather than, necessarily, an absolute preference. The disamenity effects produced by cul-de-sacs will offset their apparent benefits in infrastructure savings.

The approach that the research moves toward is not a minimization of construction cost but a maximization of the net benefits provided by a particular street grid based on the accessibility it

[11] See Crane's response to Bell in *The American City*, May 1929.

[12] 1931, p. 31.

[13] Parker, Barry. "Economy in Estate Development." Journal of the Town Planning Institute. Vol. XIV, July, 1928, p. 177-186.

[14] Asabere and Colwell (1984) found a 44% premium for vacant lots on culdesacs.

provides. The benefits of porosity, to which proximity is linked, can be compared with the costs of constructing additional paths or roads and of the opportunity cost of the land used for those roads.

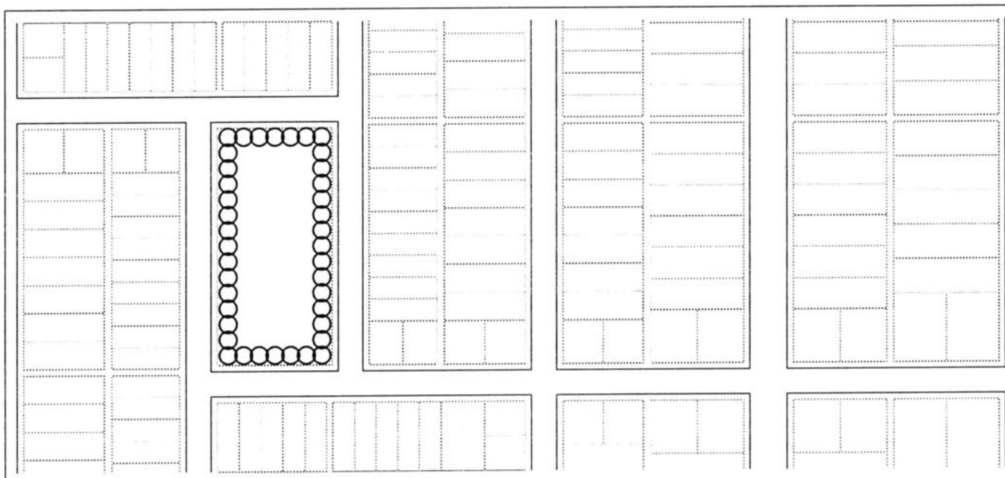
Conclusions

One clear pattern in all aspects of the work is the benefit of decentralization. Whether of the attributes of a park, or of community facilities, or of traffic, or of particular household types in a metropolitan region, sustainable community, valuable amenities, and viable financial returns do not come through the generation of economies of scale. People and communities are neither machines nor rigid processes, and respond poorly if at all to technical optimization. Instead, benefits arise by minimizing the diseconomies of scale, inefficiencies, overbuilding of markets, and concentration of risk that occur when large, homogenous neighborhoods, or oversized infrastructure, are used in an attempt to simplify the development of communities.

The physical limitations and preferences of residents impose constraints on development that are far more important than the benefits potentially derived from construction or operating economies. People will walk only a certain distance to reach an amenity, will have preferences that change over time, and can know a neighborhood up to a certain scale. Parks and neighborhoods must be designed with these attributes of the individual resident in mind to maximize their value.

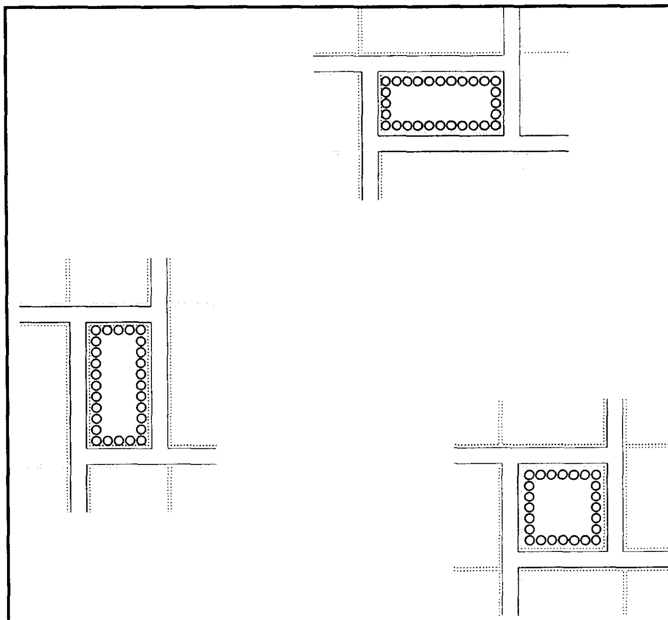
Design Rules

The boxes in the accompanying section include attempts to codify graphical rules for a few aspects of park and neighborhood design. Respecting the importance of site specific factors are general, rules are kept few and general. Several are speculative proposals as much as formal derivations.

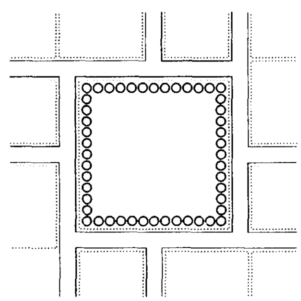


- All else equal, the smallest lots should be located closest to the park.

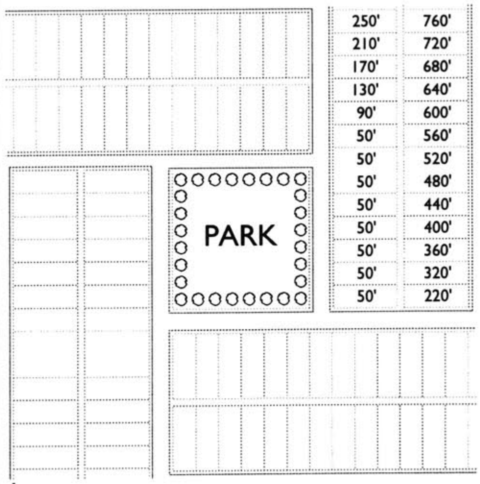
The proximity premium comprises a larger percentage of the sale price of houses on small lots than on large ones. To maximize the value per square foot of the most valuable land - that in the immediate vicinity of the park - the land should be subdivided to produce the smallest possible lots.



- Small, distributed parks are more valuable than large, consolidated ones.



Several small parks, like those above, will add more valuable to a neighborhood than a centralized park of equivalent total area, as on the right. The financial viability of this strategy depends on whether those benefits outweigh higher infrastructure costs.



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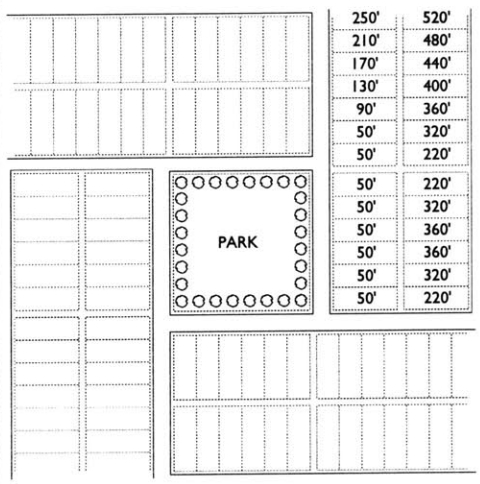


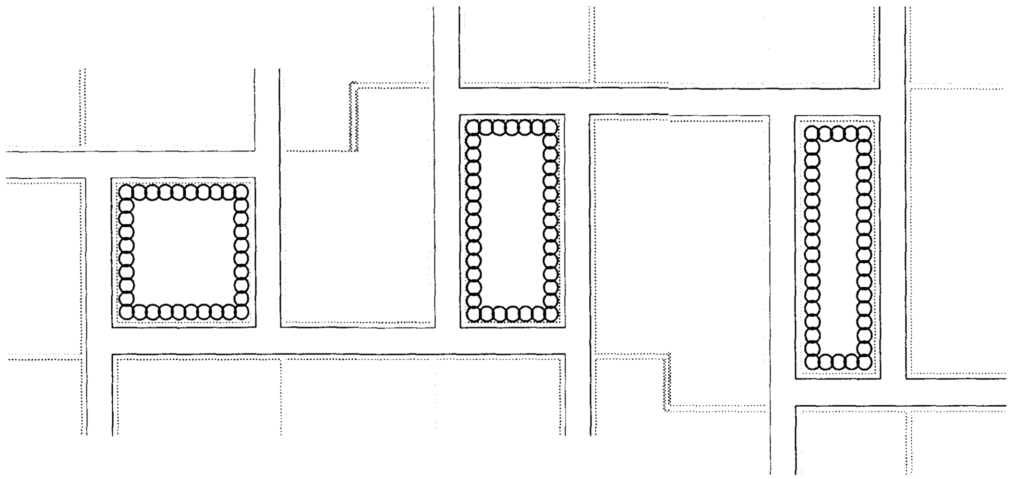
2

- Highly porous street grids are essential in maximizing property value.

As the number of available paths increase, the area within a given travel distance becomes circular in shape. Indirect paths, in contrast, dissipate the value of proximity. Street porosity is most important in the immediate vicinity of the park. If this access is provided using traditional roads, however, it may displace other valuable lot frontage. Because proximity is most valuable for pedestrian use, pedestrian paths should substitute partially for paved access roads.

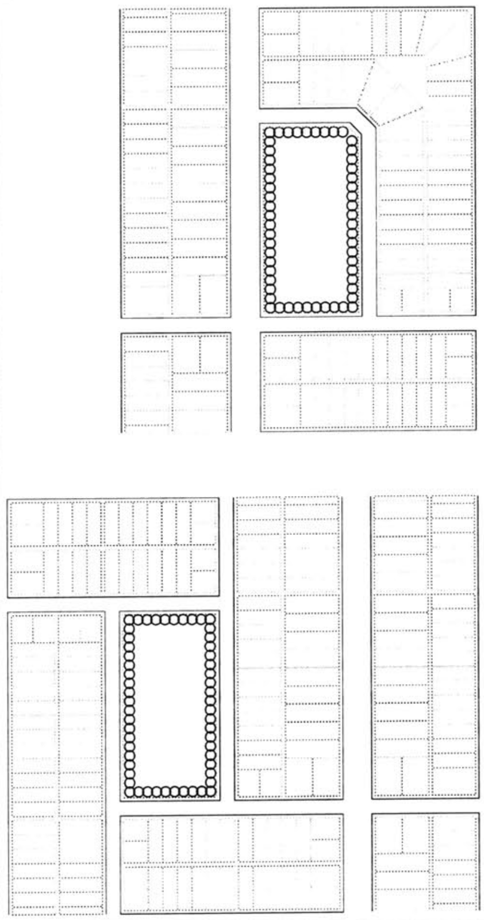
The first illustration presents a conventional pinwheel block plan. The street network is non-porous relative to the park. Radial and actual travel distance to the park diverge sharply for many lots near the park.

The second illustration shows the pinwheel block arrangement with added pedestrian paths. Here, the proximity premiums with respect to the park resemble those of a traditional gridiron plan where roads adjoined each corner of the park.



- Elongated parks are preferable to square parks if function permits.

Elongated parks increase park perimeter, all else equal, thereby boosting the net proximity premium provided by that park. A double-square park with the same area as a square park will have a 6% longer perimeter. A triple-square park, in turn, has a 15% longer perimeter.



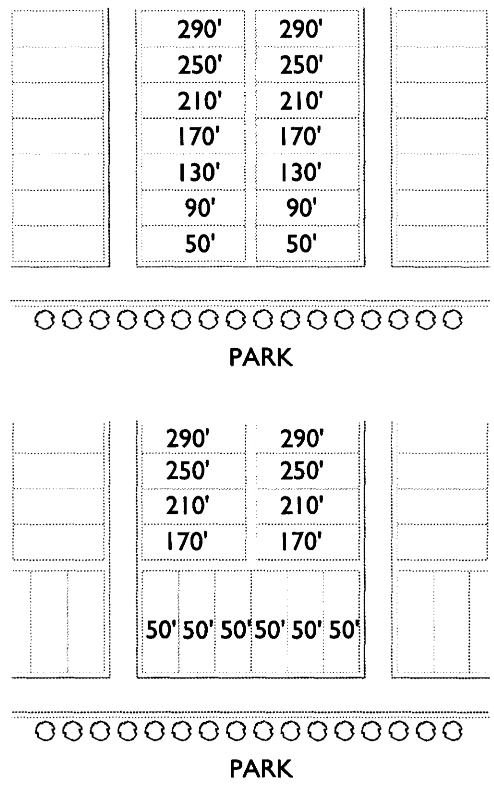
- Parks should abut the principal residential roads of a neighborhood or otherwise maximize their visibility to residents.

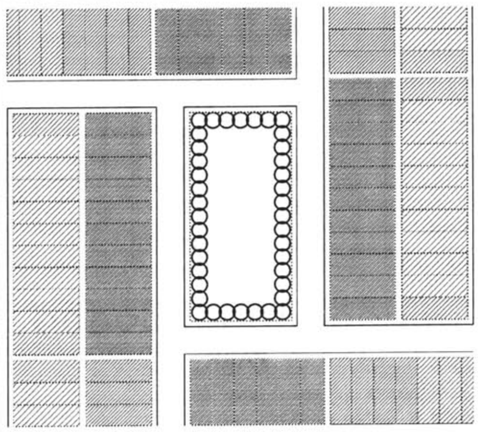
Properties near parks with abutting arterials have, on average, higher property values than those near parks with only ordinary street access. Visibility is the principal benefit accruing to parks on significant streets, and likely the cause of the price premium. The upper left diagram will be preferable to the lower right diagram, for example. If the residential arterial generates enough traffic to cut off residents on the other side from easy, safe access to the park, then this premium may not hold.

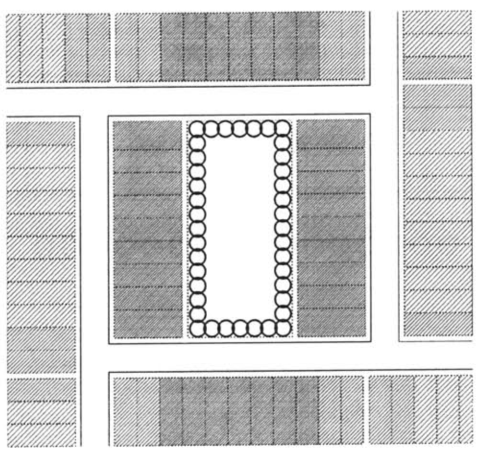
- Houses abutting parks should face onto those parks rather than adjacent streets.

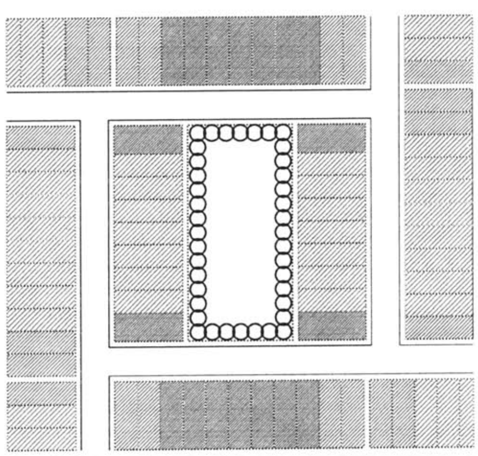
The largest premiums are for properties immediately adjacent to the park itself. The lot subdivision plan should reflect that benefit. The plan with houses fronting the park has a total park proximity premium for the parcels shown equal to 266% of the cost of a typical property. The plan without direct frontage has a net 252% premium. The difference between the two is the added alley space, here equal to 30% of a typical lot. Excluding paving costs in the alley, the plan with frontage will be preferable if land cost is less than 45% of total house sale price.

This likely underestimates the relative value of frontage. The park with houses fronting it is the more attractive, and should generate additional premiums as a result.









- Parks are more valuable when ringed by roads than when bordered by lots.

The rule, and the accompanying illustrations, have two principal caveats:

First, proximity gradients for a park with a perimeter road (top left) will be approximately the same as for a park bordered partly by lots (middle left) only if houses directly bordering the park are as valuable as those facing it across the street. Lots with the darkest shading are those closest to the park. Anecdotal evidence, as well as prior research, suggests this is not the case. If, instead, abutment to the park offers no premium, and if instead travel distance along surface streets is the critical variable, the gradients will be sharply lower (bottom left).

Second, parks with lots bordering their edges are less valuable to the surrounding neighborhood than those ringed by streets or public ways. This takes the form of a general diminution of prices in the surrounding area, rather than a reduction in the proximity premium. The diagrams do not indicate this effect.

- All else equal, neighborhood plans should be asymmetrical.

Biaxially symmetrical plans create a center for each neighborhood, but those centers cannot easily accommodate facilities serving, 1.5, 2, or more neighborhoods. Instead, to accommodate more specialized facilities, certain neighborhood centers must be formally similar to others yet provide a greater range of facilities.

An asymmetrical plan, if repeated , can accommodate a larger range of amenity drawing radii efficiently.

Symmetrical neighborhoods will tend to group amenities together and result in overlapping proximity benefits. An efficiently heterogeneous neighborhood, however, requires lots with a variety of different spatial amenity packages. The highest premium attached to lots in an asymmetrical plans will decline relative to symmetrical plans because fewer amenity gradients will affect those lots. However, these plans will produce a more diverse range of location benefits attached to lots.

Section view of a gradient around two centralized amenities. While houses further from the center have fewer amenity benefits, all houses will have approximately the same proportion of the two amenities. (This will not be the case if the two amenities have markedly smaller drawing radii.) The model is appropriate for a neighborhood where all residents value both amenity to the same degree, but have different abilities to pay. Alternately, the model is appropriate if resident preference for amenities vary, but preferences for the two amenities are tightly correlated.

Section view of the proximity rent gradients created by two dispersed amenities. Residents in this neighborhood may have a preference for one amenity that is only partly dependent on their preference for the other. As a result, the neighborhood will appeal to a wider range of resident preferences. If resident preferences for those amenities are correlated with other demographic variables, this neighborhood will support a more diverse population efficiently.

Afterword

Neither houses, parks, or neighborhoods are commodities. Their behavior and character cannot be easily quantified, and cannot reliably be reduced to simple numbers. The use of simple measures in isolation - like cost - misaligns incentives and produces inefficient outcomes, because it commodifies what will inevitably be differentiated goods.

The other side of the equation is value, and it is perhaps the more interesting one. The question is not how much something costs, but how much value it embodies. The challenge for planners, architects and developers is that cost is measured far more easily than value, particularly at the critical early stages of a project. It is natural, faced with two important factors, only one of which is known reliably, to optimize the simple, easily understood variable instead of the complex, ambiguous one. Conventional subdivision patterns reflect this tendency. Low cost, however, is not synonymous with high value. The challenge in improving the quality of the built environment - and in profiting thereby - is to make the case that value is just as important as cost in determining the market viability of a house, park, neighborhood, town, or city.

It is only when designers can articulate the benefits as easily and clearly as costs - and can do so in a manner that allows direct comparisons to be made between alternatives - that the lowest cost tendencies of suburban markets can be replaced by more sustainable and profitable options. This now occurs only in isolated cases, because it requires a sophisticated, perhaps foolhardy, leap of faith in the future performance of a design. Indeed, in the short term predictive design metrics will permit those more sophisticated players - whether developers, financiers, architects, or site planners - to better defend their market positions and extract superior rewards for their efforts. In the long term, however, to create the communities that are worth living in, those metrics must be adopted by the small, independent developers now responsible for much of the built environment.

This exploration of the value of neighborhood parks, then, is only one of a great number of such studies that could be undertaken. Even this limited topic expands rapidly in scope because the behavior of parks depends on the whole of their surroundings. To pursue the implication of park premiums too narrowly would be to commit an error similar to those of progressive planners who proposed neighborhoods designed to minimize - indeed eliminate - four-way intersections. The conventional wisdom about pedestrian safety is important, but it is not the raison d'être of neighborhoods. So with parks.

The value of the research, then, is to provide tools with which the expected performance of some proposals can be evaluated, and extrapolations reliably made about the performance of others. It also permits some carefully qualified rules to be proposed for the use of designers. The hazard of rules, however, is that their generality conceals interesting opportunities. Because one starting point of the thesis was that oversimplified rules about optimized neighborhoods are partly responsible for the banality of conventional development, I am reluctant to substitute my own, updated oversimplifications.

However, the power of models like this could grow almost exponentially as their scope increases. Each new variable adds not just one additional conclusion, but the potential for further insights into each of the variables already incorporated. For this reason, the findings should be understood as preliminary. They will not, hopefully, be subject to revocation, but rather to future refinements that will offer far more sophisticated insights into the behavior of residential property values and the role of amenities and of design in those values.

Neighborhood plan proposal

The development of one resolution of the neighborhood plan begins with a series of diagrams derived from the research.

The retail core is sited first, and parks are distributed accordingly. Judgments about market preferences determine the relative size of the parks, and the placement and proportion of those parks is adjusted to maintain alignments and preserve potential rent gradients. Lot distribution is based on analysis, tempered by assumptions about potential market absorption.

To some degree, the proposal attempts to resolve one set of issues not answered by the research data: namely, how the proximity benefits of different parks interact with one another. It represents only in part an application of the research findings. More importantly, it is a way of clarifying a set of issues inherent in those findings, and exploring a potential solution that might be in general sympathy with the broad outlines of the research. It is intentionally theoretical in nature.

There is not a specific site for the proposal, but the plan reflects general site conditions in the Dallas area. In a rapidly growing region, dominated by conventional development, the experience of the periphery is of polished but very low density development abutting farmland or scrub fields. This sense of the absence of context as the defining site characteristic underlies the choice of a generic regional site.

Park Methodology

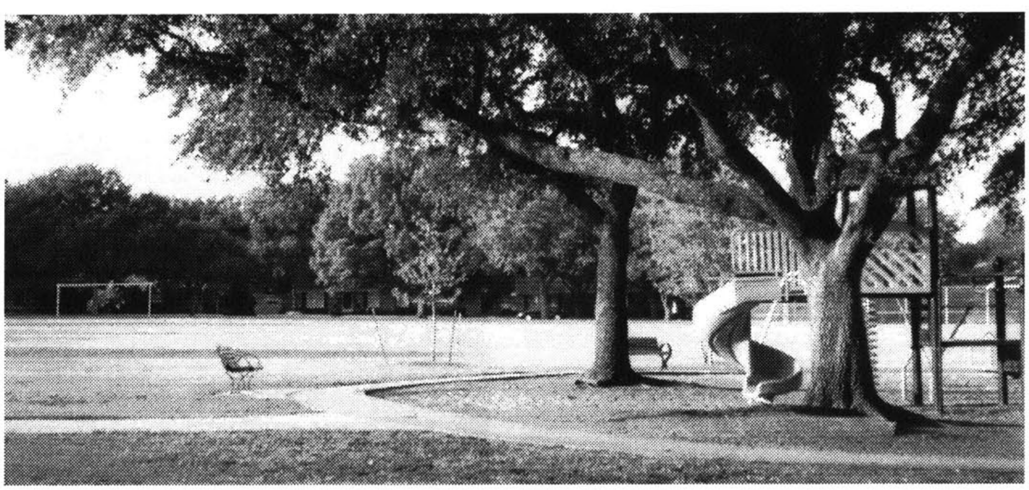
The design of the park system is a predicated on a dual concern for maximizing the proximity of parcels to the network of green space, and on preventing dilution of the rent gradients associated with those parks from the values derived in the research. The strategy is three-fold.

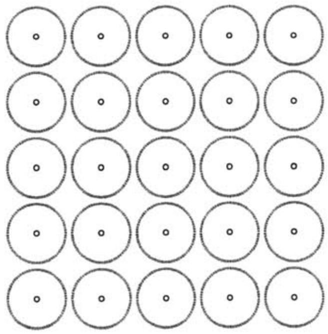
First, the parks are connected by a continuous system of stormwater collection, drainage, and retention. In this way, the distributed park system adds value to the system beyond that provided by a centralized park. This network provides a continuous canopy for wildlife, and serves as the principal design element in the park network.

Second, a form language of landscape elements organizes the experience of the parks. This language is based on elements in the research parks and on the experiential effect of those parks.

Third, functional uses, corresponding to expected population groups, differentiate the parks from one another. The largest park provides athletic space for organized sports, and serves a younger population living at higher densities. A second park incorporates a playground, sheltered from the hot sun by a grove of large trees, as the central element. A third park serves a passive leisure audience, and, with space for a future wetland, is the most naturalistic of the three.

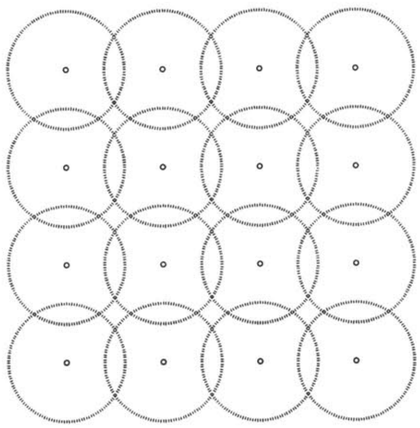
The latter two parks serve families with young children or older residents. Lots around these parks are larger than elsewhere in the neighborhood, and the parks themselves, less intensively programmed, support a less rigid maintenance program.





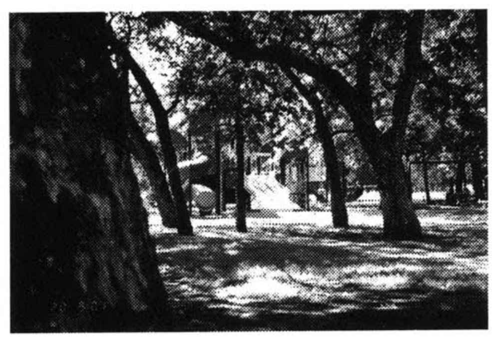
Copse

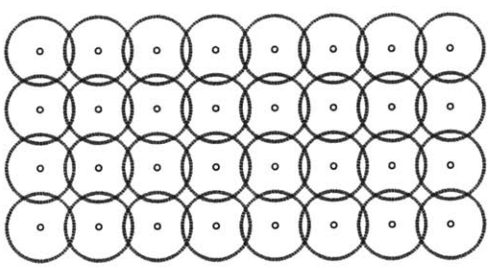
A small, tight cluster of trees, harvested on a short cycle. Perceived as a figural group in the landscape.



Grove

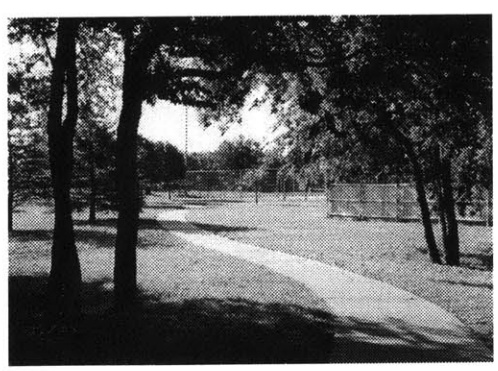
A group of large, generously spaced trees. Groves can shelter picnic and play areas.

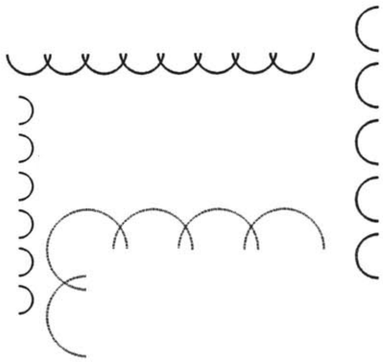




Bosque

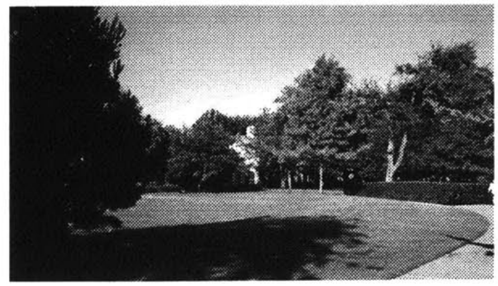
A group of closely planted trees casting dense shade. The bosque offers more sheltered space than the grove.

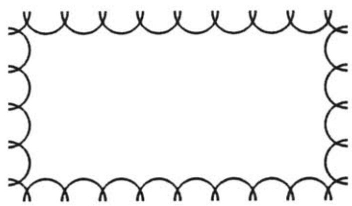




Meadow

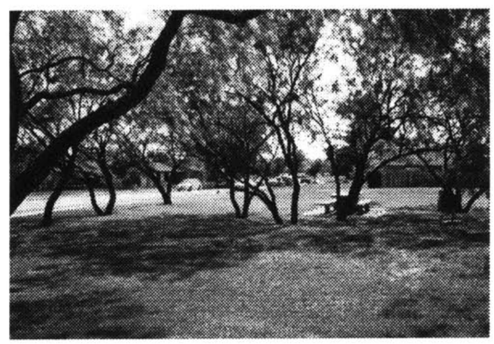
A clearing between groupings of trees.

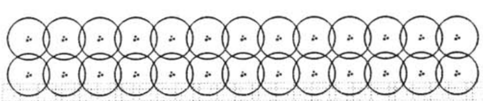




Glade

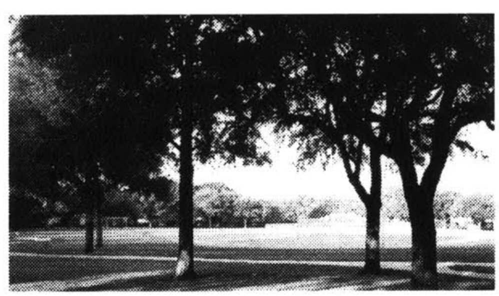
A clearing within a contiguous grouping of trees.

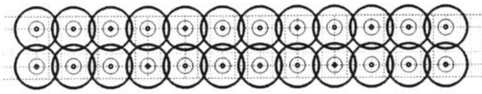




Double row

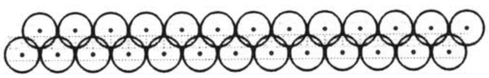
A tight planting of trees shielding the park from adjacent streets, and forming a backdrop for the park itself. A path follows along one edge of the row, just under the arching branches above.





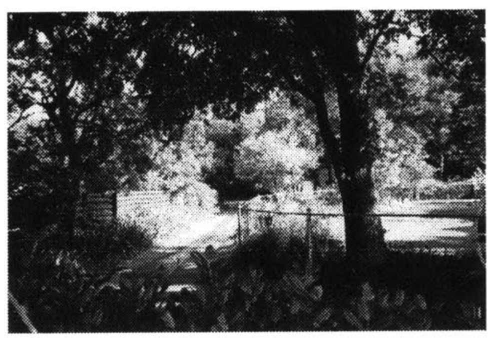
Allee

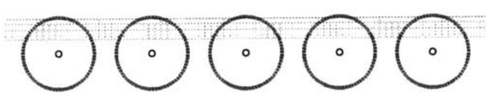
A double row of symmetrically planted trees bordering a path. It need not imply infinite extension.



Alley

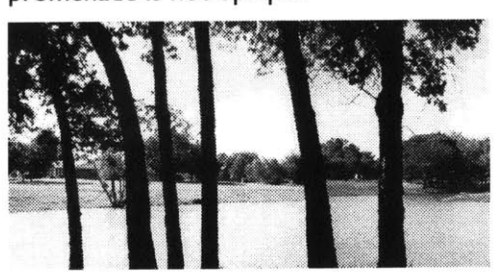
A small path between private lots, bordered by staggered trees.

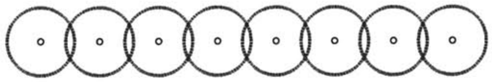




Promenade

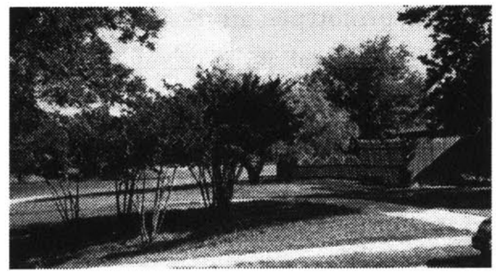
A row of ornamental trees following a path. Unlike the double row, the promenade is not opaque.

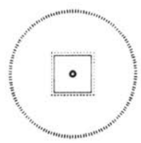




Scrim

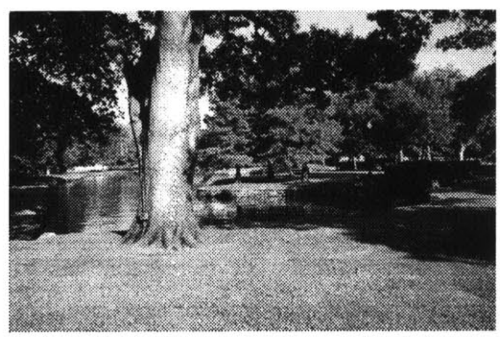
A row of trees offset before a background. It deflects the gaze while creating depth.

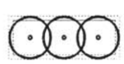




Specimen

A single tree presented as a focal point.





Bed

An ornamental group of low plants near an entrance.

Street Sections

In keeping with the variation in densities across the neighborhood, street section prototypes are distinguished as being more rural, more urban, or urban. Distinctions among the types are based on curb, sidewalk, and planting bed treatment, and on the basic architectural treatment of the facade and porch with respect to the street.

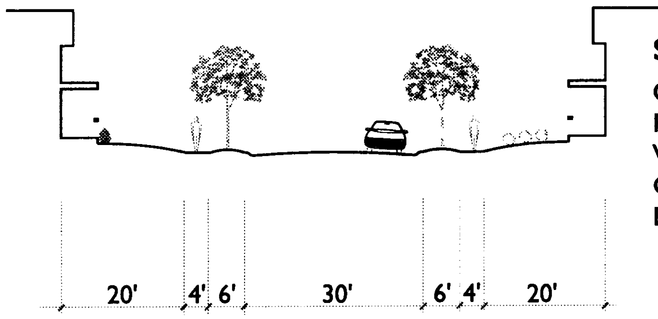
The more rural type has rolled curbs, a wide, rounded planting strip, and a narrow sidewalk set in from the street. House gables are parallel to the street, and porches, fully detached, engage the mass of the house with the public space. The land slopes gently down to the earthen edge of the drainage channel.

The more urban type has poured curbs, a narrow planting strip, and wider sidewalk. Gables are perpendicular to the street, and the semi-engaged porches are set closer to the street. The green space of the boulevard is more formal, and the edge of the drainage channel is poured.

The urban type has in addition to a poured curb a narrow paved strip for people exiting parked vehicles. The planting strip is narrow, with trees either in cutouts in the paving or in a gravelled strip. Houses are set close to the street, and porches are fully engaged with houses. Landscaping is minimal, and the adjacent buildings play the principal role in defining the public space.

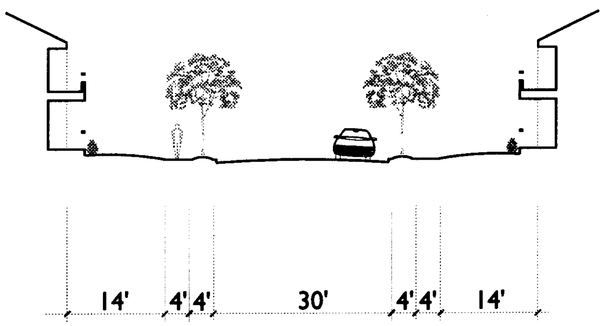
Three road types, the street, the boulevard, and the 'green street', serve the neighborhood. The street is the primary, default type of the neighborhood. Boulevards connect each park, and are as much part of the park system as the street system. Green streets, the third basic type, represent a hybrid of the first two. Heavily planted like the boulevard, the green street is more pedestrian-oriented in nature. The most urban green street provides a spine of pedestrian access leading from the large park to the retail core. More rural green streets lead from pedestrian pass-throughs on long blocks back to neighborhood through-streets.

Variation in street styles is small relative to the extremes of urban experience because the individual neighborhood is in part a homogenous group. The different street sections representing ordering devices for the neighborhood more than a fundamentally different experience.



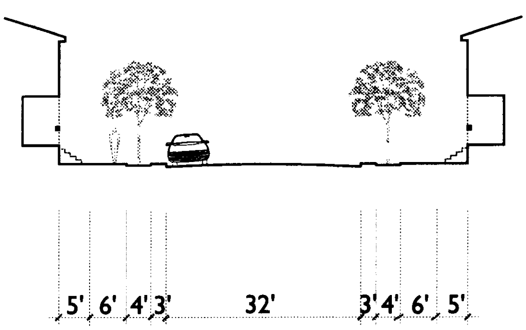
Street - more rural

On-street parking
Rolled curbs
Wide planting strip
Gables parallel to street
Detached porches



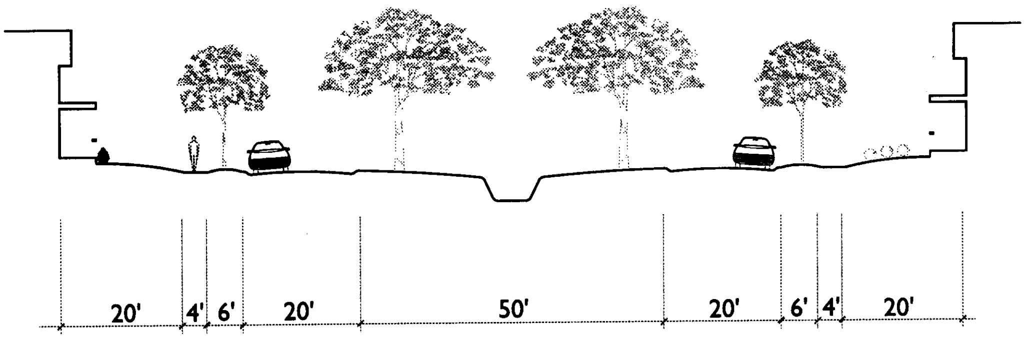
Street - more urban

On-street parking
Poured curbs
Narrow planting strip
Gables perpendicular to street
Partially detached porches



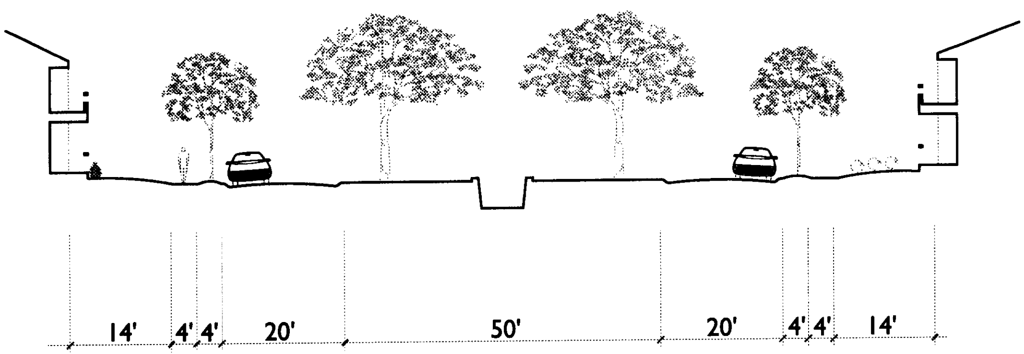
Street - urban

On-street parking
Parking on both sides
Paved parking strip
Perpendicular gables
Elevated first floors
Fully attached porches



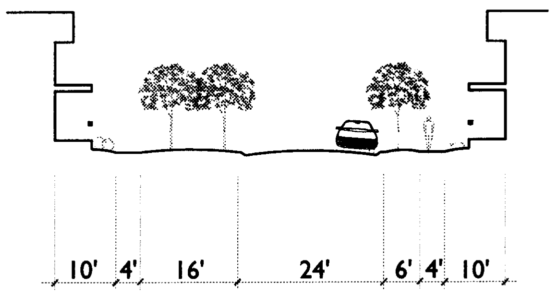
Boulevard - more rural

Rolled curbs
Wide planting strip
Gables parallel to street
Detached porches
Earthen drainage channel



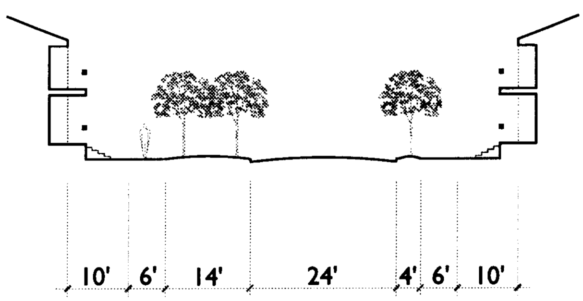
Boulevard - more urban

Cast curbs
Narrow planting strip
Gables perpendicular to street
Partially detached porches
Lined drainage channel



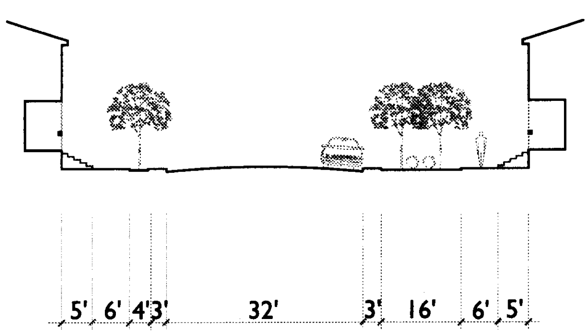
Green street - more rural

On-street parking
Rolled curbs
Wide planting strip
Gables parallel to street
Detached porches



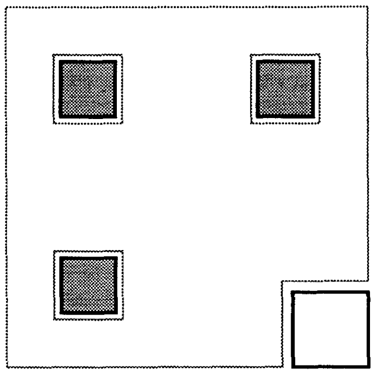
Green street - more urban

On-street parking
Poured curbs
Narrow planting strip
Gables perpendicular to street
Partially detached porches



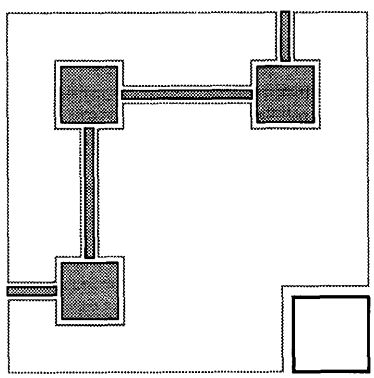
Green streets - urban

On-street parking
Parking on both sides
Paved parking strip
Perpendicular gables
Elevated first floors
Fully attached porches



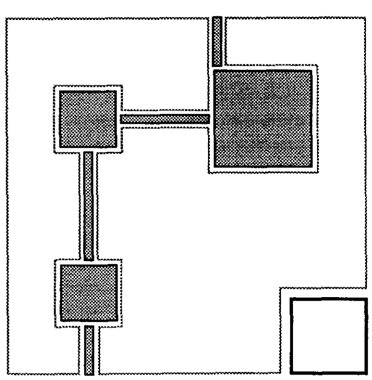
1

The retail space sits at the corner abutting two arterials. Three small parks are placed equidistant throughout the remaining residential land.



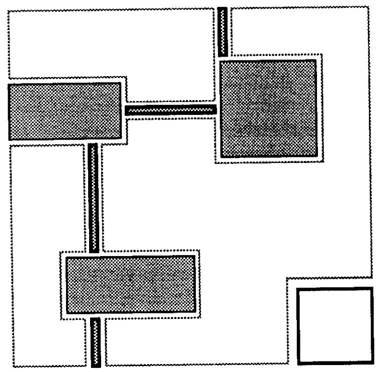
2

A series of green streets connects the parks and provides potential links to adjacent neighborhoods.



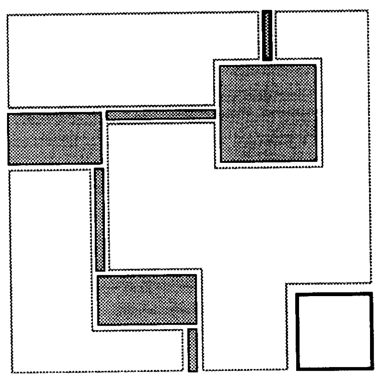
3

One larger park provides space for active uses and a zone, between it and the retail area, for denser development.



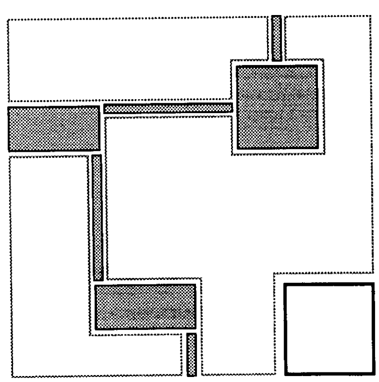
4

Smaller parks are repositioned in response to the drawing radius of the larger park.



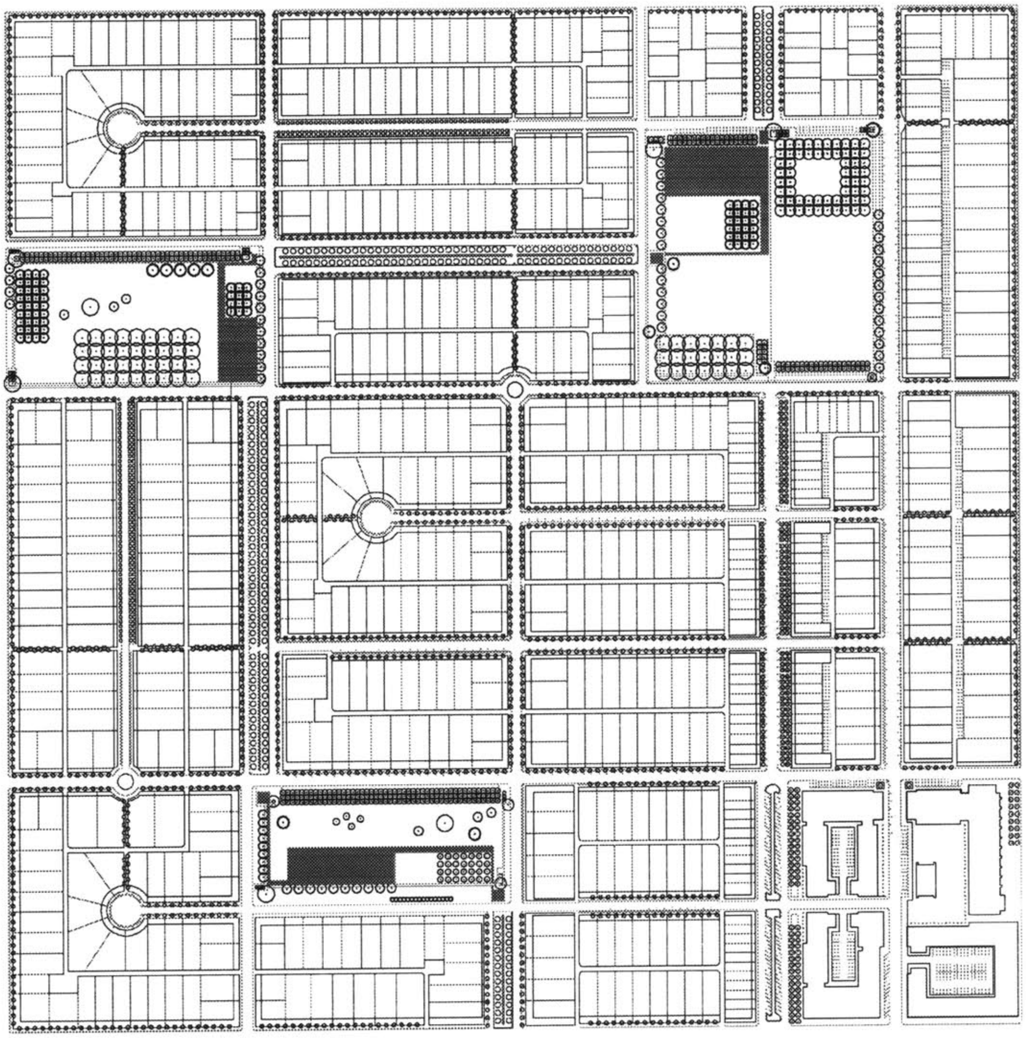
5

The plan shifts to provide a regular set of relationships between parks and green streets.

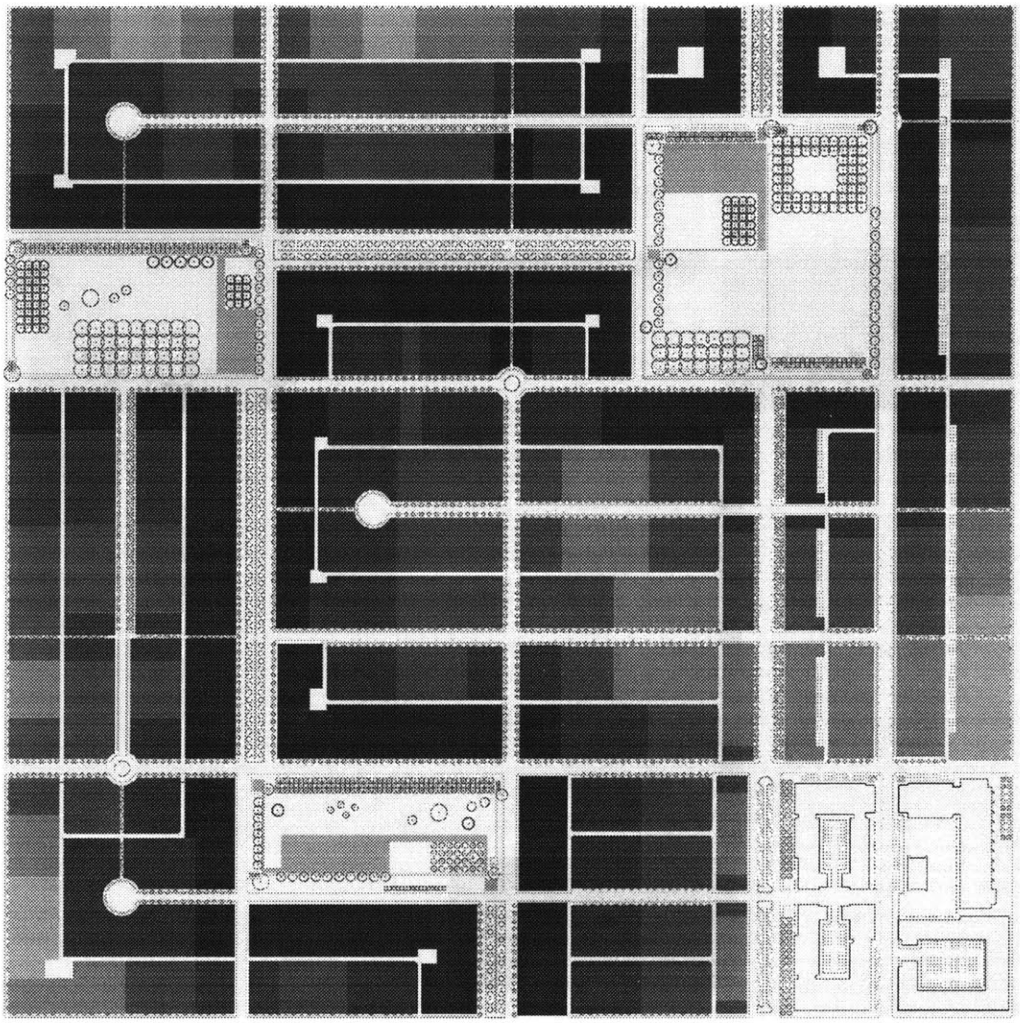


6

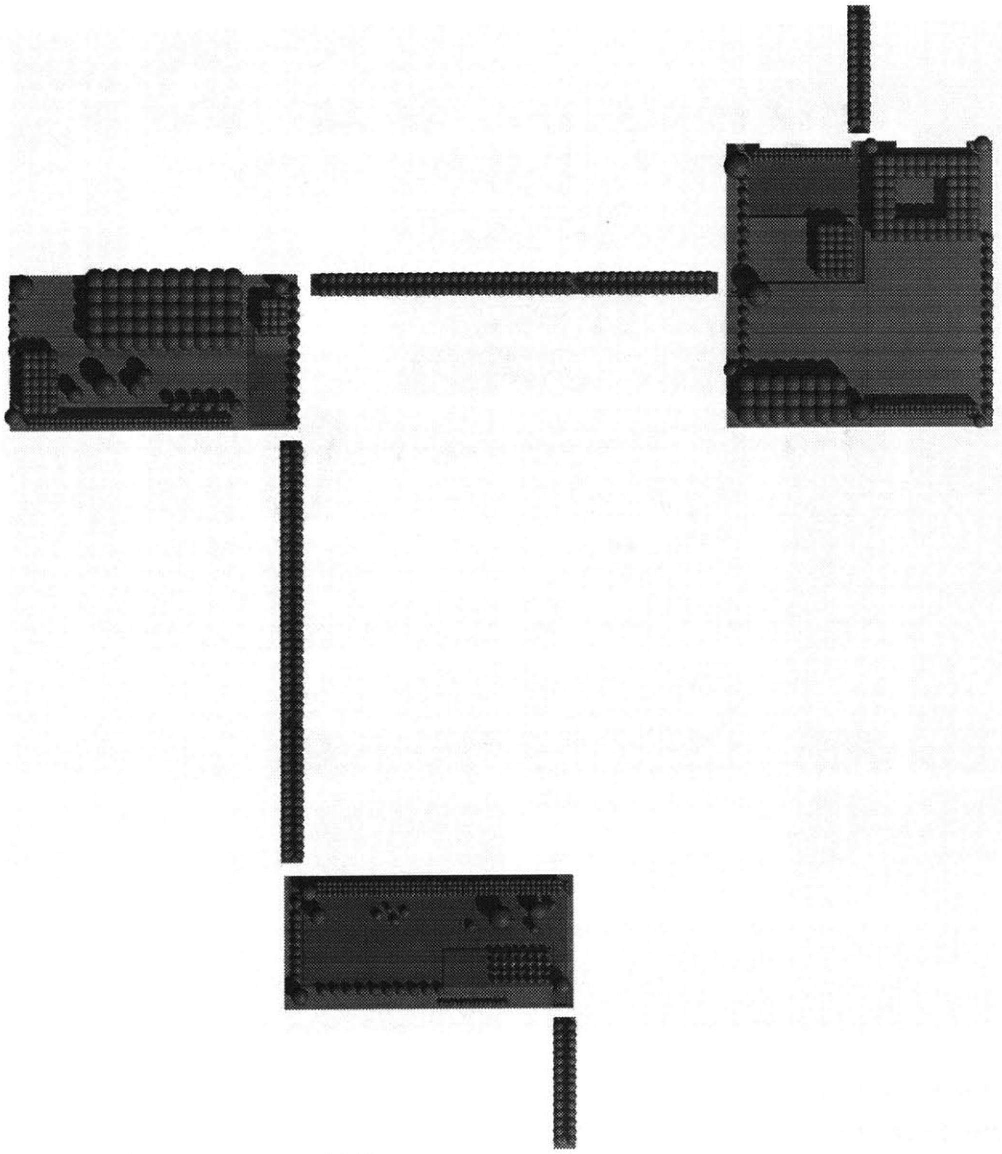
Parks and green streets are resized to accommodate typical block sizes.



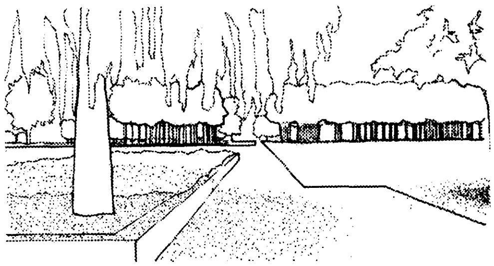
Neighborhood plan



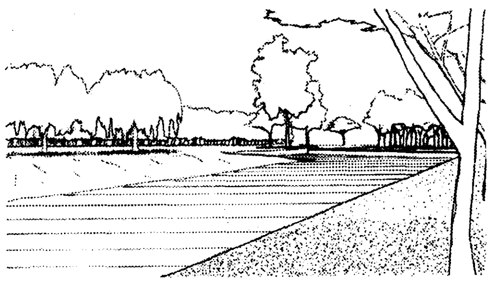
Neighborhood plan showing
proximity effects



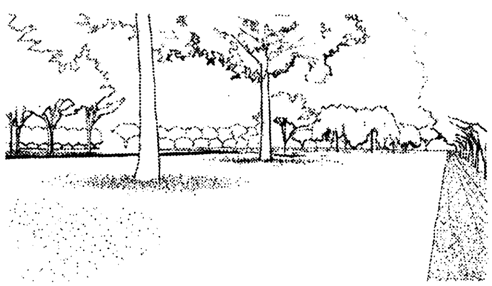
Park plan showing massing of foliage



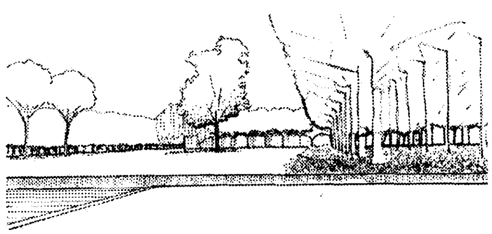
View around grove sheltering park



View from entrance to recreation park across field



View from leisure park toward pond



View across retention pond in leisure garden

Appendix - Study Parks

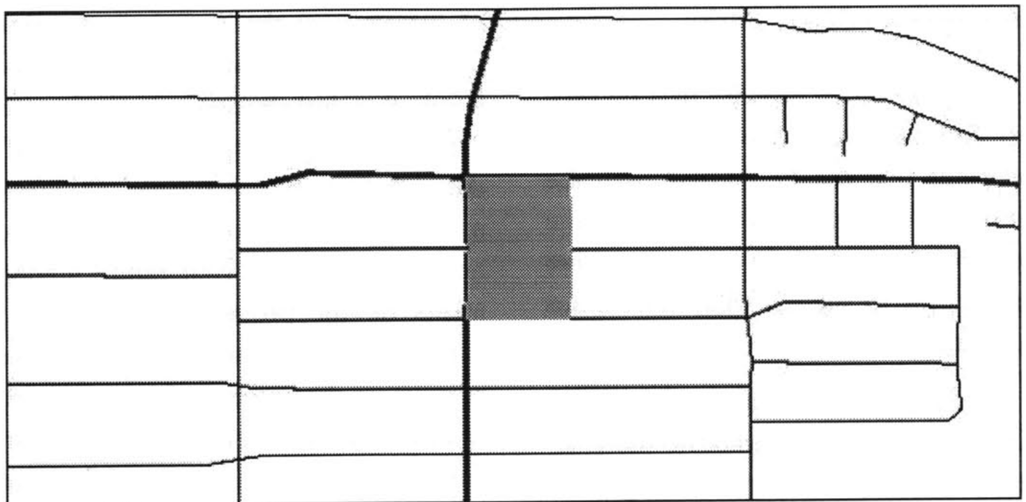
This section includes data on each of the parks used in the study. The conclusions that can be derived from the research depend in part on the nature of the sample, and the appendix serves principally to suggest what those limits might be.

An additional benefit of the studies, however, are to delineate the character of suburban recreational space in Dallas. Many of the parks are intermittently maintained, and few are designed in a way that optimizes park frontage or even accessibility. In short, the premiums derived from the research reflect a standard of park quality well within reach of an even marginally committed developer. National monuments these are not.

A point worthy of reemphasis is how much variation exists even within the neighborhood park designation. The difficulty of developing a reliable methodology for park characteristics, and the limited size of the sample set, limited the use of more sophisticated treatments of these factors. Additional research, perhaps employing a larger set of parks, could produce more sophisticated analyses of the marginal impact of particular park attributes on neighborhood value.

The diversity in the arrangement of streets near the park indicates the formal diversity even among neighborhoods that feel distressingly similar on the ground. The experiential quality of the path from house to park will differ markedly in many of these neighborhoods, and may permit future refinements of the proximity specification. One such future improvement would be to measure the number of intersections or turns needed to reach the park, rather than relying on a distance-based proxy for path complexity.

Last, the park data indicates the diversity of park size captured under the neighborhood park designation. The City of Dallas, for example, categorizes 168 of its parks as neighborhood parks. The mean park acreage is 7.5 acres, but the standard deviation is 10.2, ranging from 0.1 acres to 70.9. (Numbers based on data from a City of Dallas internal parks document, dated 1/3/00.) Even the definition of neighborhood park used at the outset of the thesis permits many different park sizes and designs.



Preston Hollow Park

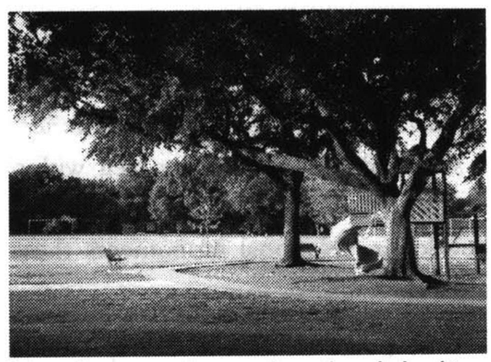
Dallas, Texas

Park Amenities

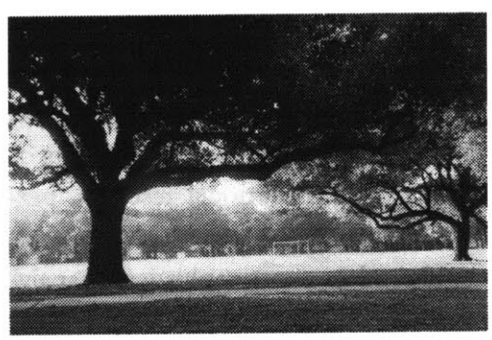
Park acreage	7.2
Playground	y
Picnic area	y
Baseball field	y
Soccer field	y
Water feature	n
Basketball court	y
Tennis courts	y

Park Perimeter Characteristics

Subcollectors.........0.0%
Minor roads.......100.0%
Private lots.............0.0%
Alleys.......................0.0%
Other.......................0.0%



View from northern edge of park, looking south past playground at soccer field.



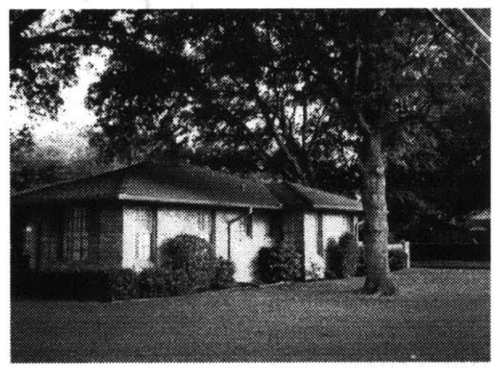
View looking southeast across park.

Preston Hollow Park is a full block park located just north of the city of University Park. The park has a large ball field, with back fence and bleachers, in the southwest corner of the park facing northeast. There is a smaller ball field opposite it on the meadow. There are two tennis courts in the northeast corner, and a tetherball court immediately west of that. To the west and south of this is a large playground, with a large pre-cast concrete picnic structure.

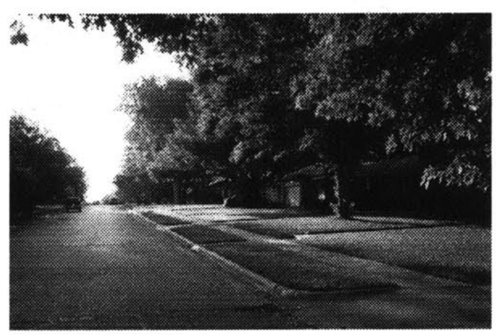
Landscaping is fully developed. A perimeter of mature oaks borders the park, with an additional grove between the playground and the meadow. There are small flowerbeds near the northwest corner entrance. The lawn is well maintained.

The surrounding neighborhood is established, appearing to date from the 1930s. Homes in the immediate vicinity of the park are mostly one-story, early ranch style homes. A few have corner windows or arts and crafts details. Adjacent houses front onto the park Only some of the houses on Turtle Creek Boulevard do. Others maintain a fenced backyard up against the sidewalk. Several streets, particularly Turtle Creek Boulevard, are landscaped lavishly.

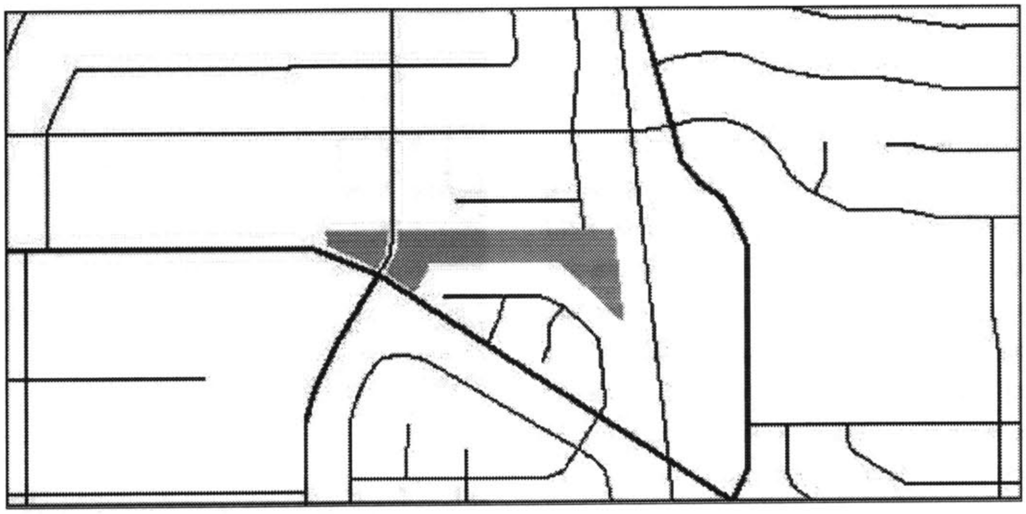
View of landscaping near playground.



View of older house in park vicinity.



View east of streetscape on Turtle Creek Boulevard.



Woodhaven Grove Park

Richardson, Texas

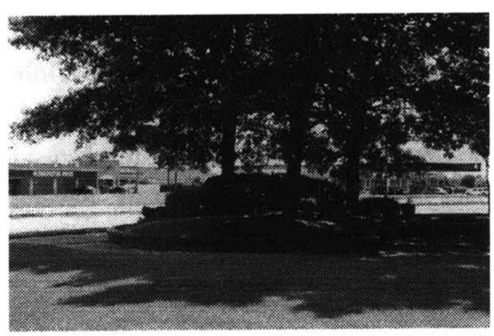
Park Amenities

Park acreage	3.3
Playground	y
Picnic area	y
Baseball field	n
Soccer field	n
Water feature	n
Basketball court	n
Tennis courts	n

Park Perimeter Characteristics

Subcollectors..............14.5%
Minor roads.........,,0.0%
Private lots...........10.2%
Alleys.....................75.3%
Other.......................0.0%

View looking east from picnic structure.



View looking southwest across Centennial Boulevard at strip malls.

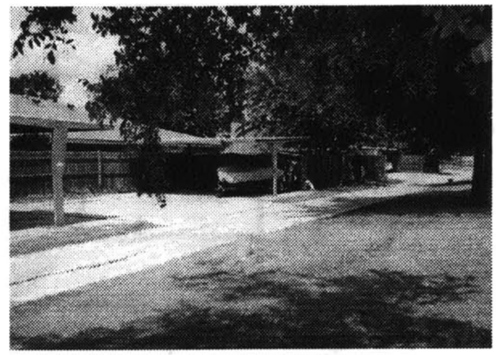
Woodhaven Grove Park is a long, narrow park in Richardson, Texas. The Richardson Centennial Water Tower to the east dominates the park. An electrical substation sits at the base of the tower, but is shielded from direct view by a nicely built masonry wall.

No houses front directly onto the park. Houses back onto the park on the north and south, with garages or parking structures accessed by 10' wide single-loaded alleys.

A rolling lawn dominates the park. There are some mature shade trees and many semi-mature ones. Artificial hills and pointlessly winding paths provide some visual interest. The park includes a covered picnic structure and a small barbecue box.

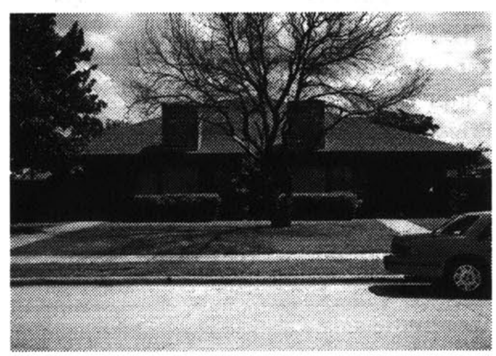
The park has a small parking lot for four cars, and plenty of on-street parking. The park has no public facilities. The nearby intersection is heavily traveled, and its noise is audible in the park. A strip commercial development sits on the southwest corner of that intersection.

The park is a compromised park set in apparently leftover space. Homes take no advantage of the park for orientation, and the park therefore feels unowned by the surrounding neighborhood.

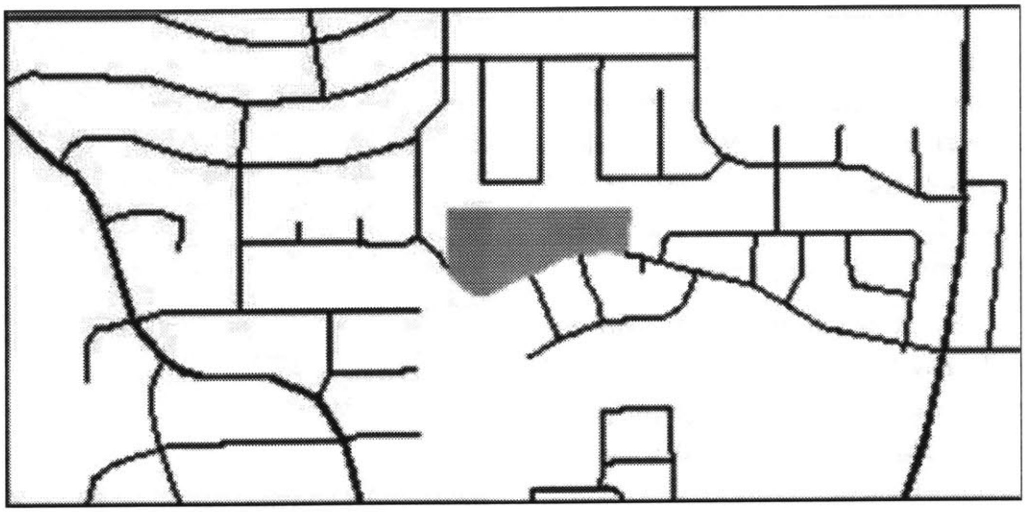


View looking northeast at alley and parking structures

View east along southern edge of park, looking at alley, back fences, and garages.

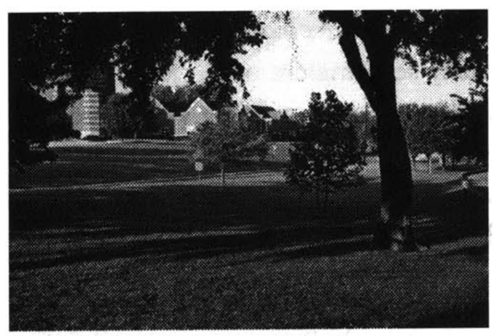


View of duplex abutting park to the north.



Bentwood Park

Dallas, Texas



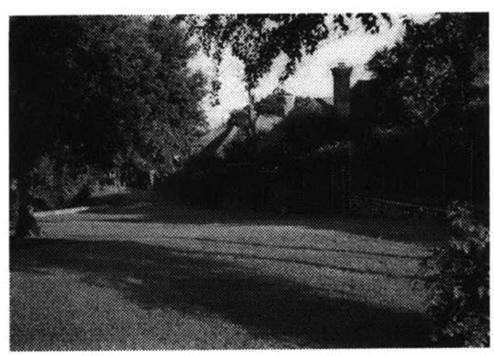
View looking south from park.

Park Amenities

Park acreage	5.8
Playground	y
Picnic area	y
Baseball field	n
Soccer field	n
Water feature	y
Basketball court	y
Tennis courts	y

Park Perimeter Characteristics

Subcollectors..........0.0%
Minor roads.........46.0%
Private lots...........22.7%
Alleys.....................31.2%
Other.......................0.0%



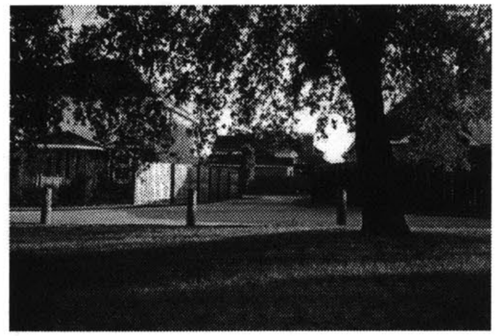
View along northern edge of park.

Bentwood Park is an oblong park bordered by roads to the south and west, alleys to the east, and houses to the north. To the north, the backs of houses open onto the park. There are two tennis courts at the eastern end of the park, and a children's playground and a basketball court to the west. A retention pond dominates the west side of the park, surrounded by large, mature deciduous trees. The park has two parallel parking spaces, separated from one another. The park is clean, but not well maintained.

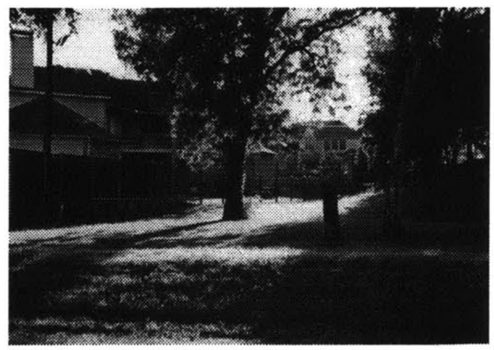
Back yards abutting the park are fenced with high wood fences. Homes abutting the retention pond have high wrought iron fences instead. These houses have mature landscaping dating from the 1980s. Houses have two stories with high entry spaces and gable roofs. The architectural detailing is atrocious.

Alleys are common in the surrounding neighborhood. Between wide roads and alleys, the neighborhood infrastructure looks overbuilt. The neighborhood feels porous because of these alleys, but the dendritic plan hampers pedestrian travel.

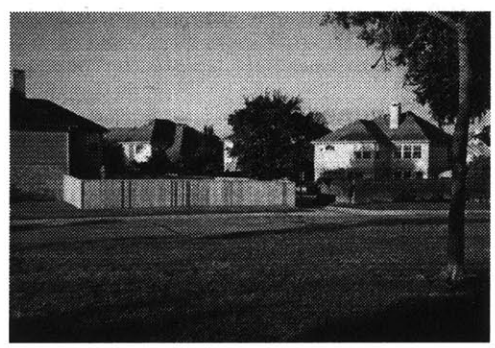
The park has the split personality of many newer parks in the region, fulfilling both functional and recreational needs but presenting no coherent image to the neighborhood.



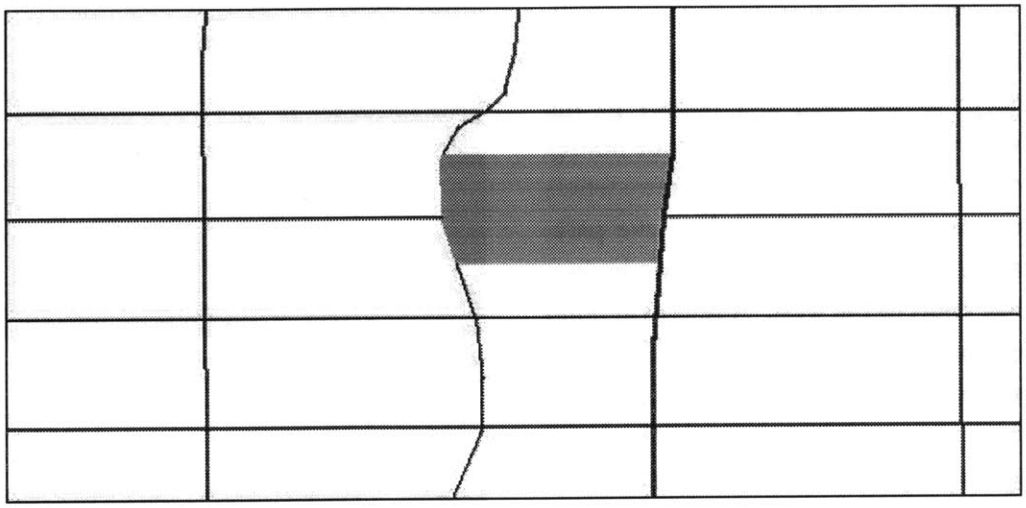
View north from park toward alley



View of fences along northeast corner of park.

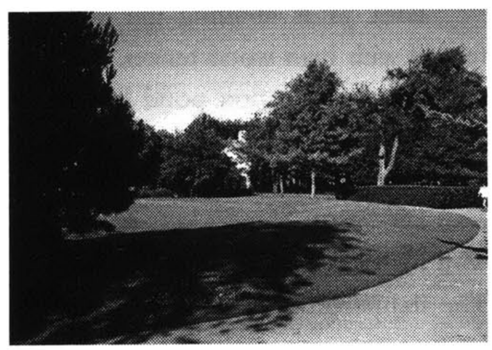


View of side yard treatments.



Caruth Park

University Park, Texas



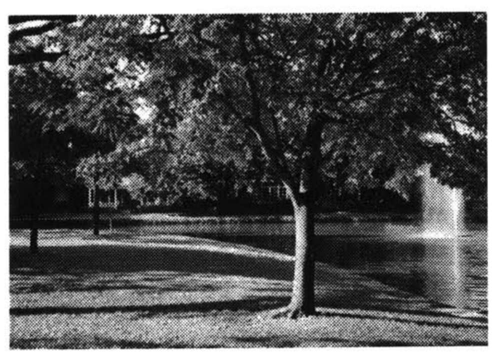
View looking across park.

Park Amenities

Park acreage	5.0
Playground	y
Picnic area	y
Baseball field	y
Soccer field	n
Water feature	y
Basketball court	y
Tennis courts	y

Park Perimeter Characteristics

Subcollectors	17.1%
Minor roads	17.3%
Private lots	64.7%
Alleys	0.0%
Other	0.0%



View looking south at water feature.

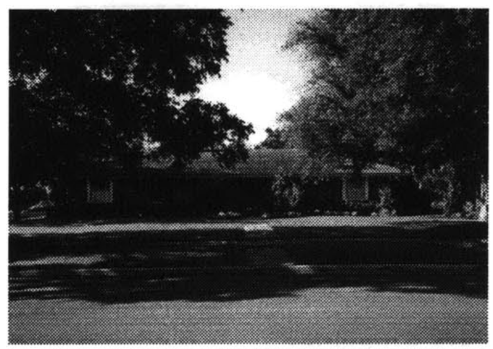
Caruth Park is a lush, manicured five-acre park near the northern edge of the upscale Dallas suburb of University Park. The park includes a large, multi-leveled pond in its southwestern corner. The western edge of the park is designed for passive leisure, with rolling hills and curving paths. The northwest corner has two tennis courts and a childrens' playground.

Landscaping is mature and well maintained. Most trees are deciduous, except where evergreens are used as visual shields. The park has floral plantings at the entry points. Grass is extensively irrigated and very lush.

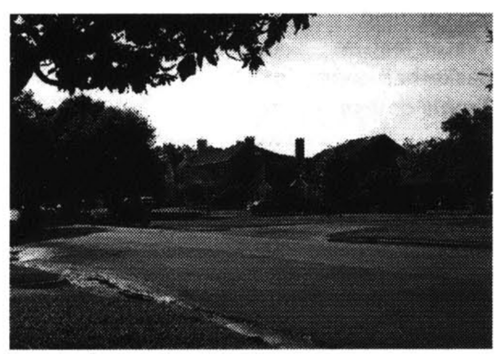
Houses along the northern side of the park are almost exclusively fenced off from the park with opaque wood fences, up to ten feet tall.

Blocks to both the east and west of the park are orthogonal, with well-developed shade trees, extensive setbacks, and alleys. Many of the houses to the north are low and in the prairie style, while many houses to the west look older. Setbacks are ample throughout the neighborhood. There is extensive renovation and teardown new construction in the neighborhood. New houses are universally two-story in a variety of traditional styles.

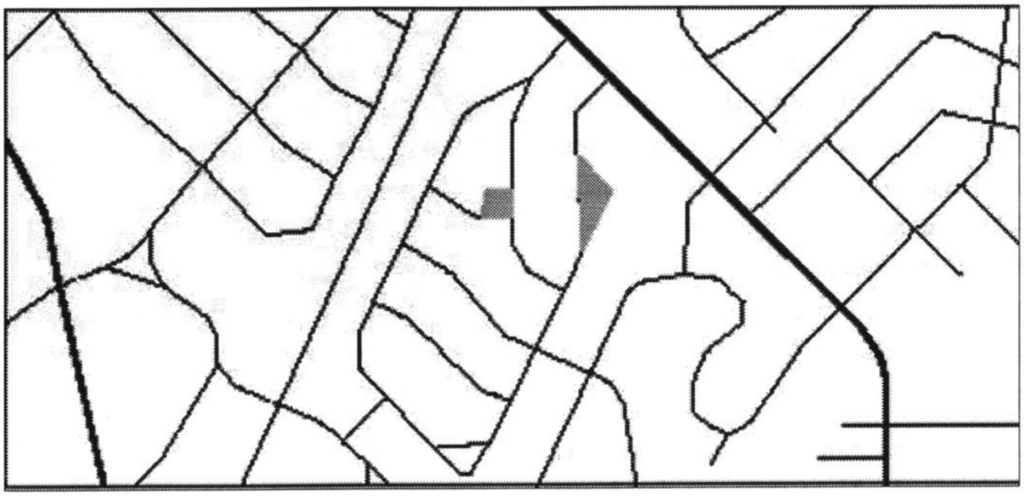
View of newly built home north of and abutting the park.



View of unimproved house north of and abutting the park.



View of nearby street, showing range in house sizes.



Jones Park
Dallas, Texas

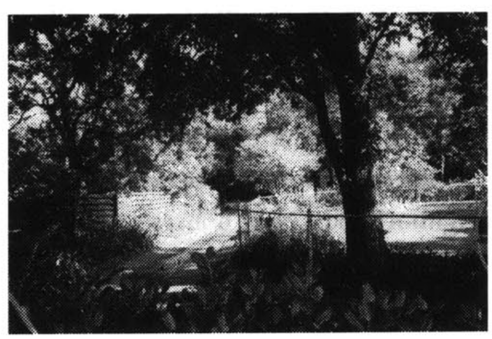
View looking north at ornamental park.

Park Amenities

Park acreage	0.3
Playground	y
Picnic area	n
Baseball field	n
Soccer field	n
Water feature	n
Basketball court	n
Tennis courts	n

Park Perimeter Characteristics

Subcollector	0.0%
Minor roads	57.7%
Private lots	42.3%
Alleys	0.0%
Other	0.0%

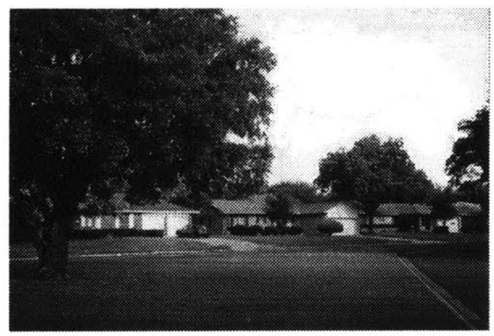


View from edge of playground, looking down alley at gardens.

Jones Park is actually a pair of small, irregular parks located east of White Rock Lake. The first of these, without formal name, is a triangular park bordered by roads. Jones Park Playground has just that, a small playground with a perimeter of small shade trees. The other park has some poorly maintained ornamental plantings. An alley ends on the park from the north, serving houses on both street

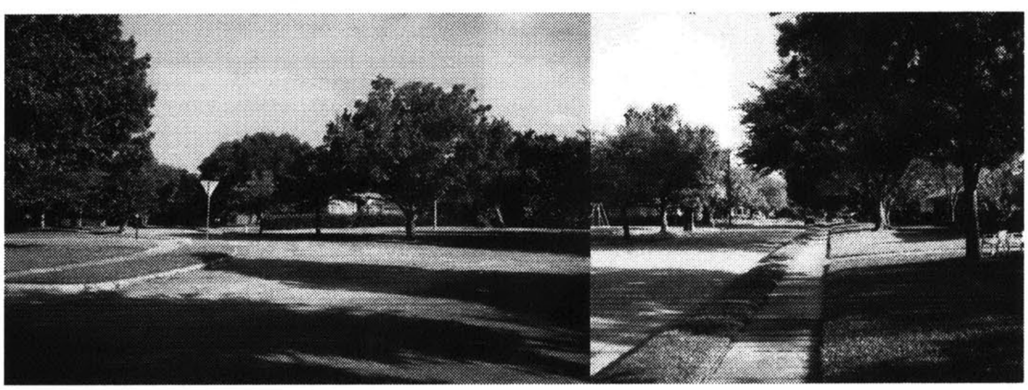
View of typical home in neighborhood

Many homes in the neighborhood have bungalow details like exposed eaves, oversized pier columns, or small windowpanes. Homes are generally neat and well maintained. Many properties to the northeast are undergoing renovation.

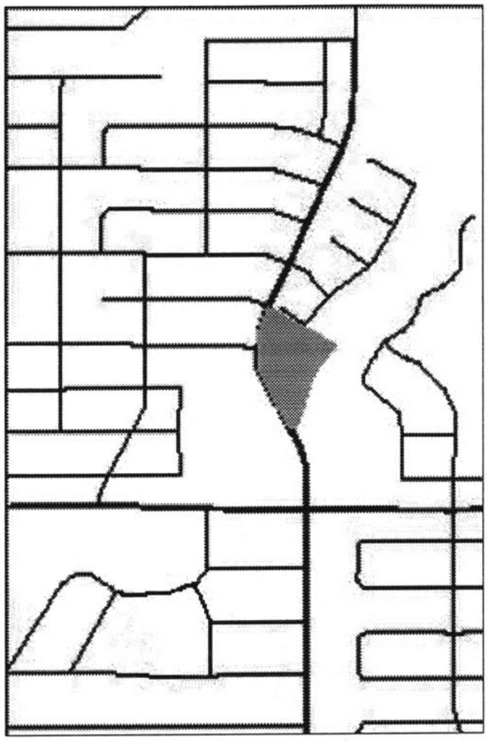


View across park at neighbors.

The neighborhood has a mix of properties with attached garages, alley access, and front-accessed garages behind the houses. Trees provide much of the neighborhood's character and beauty.

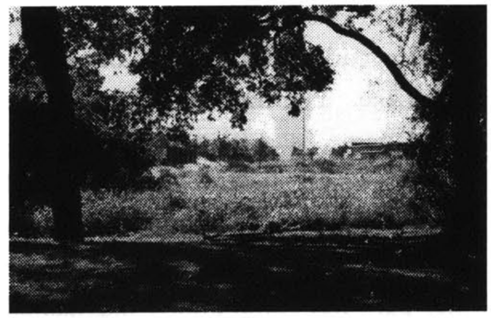


View of Jones Park Playground.

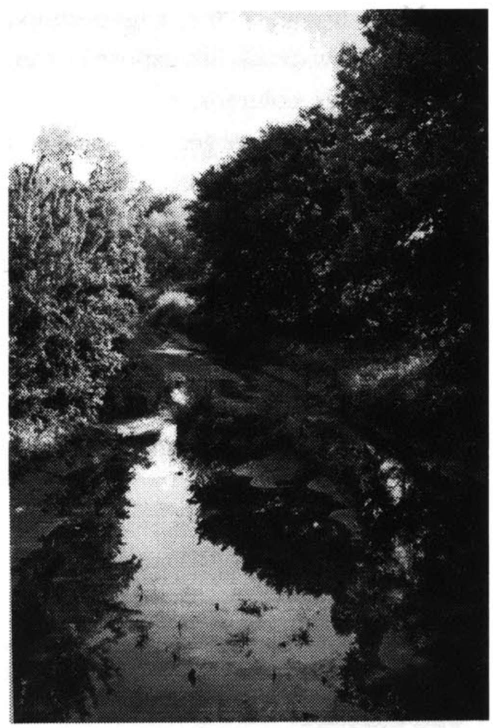


Frankford Park

Dallas, Texas



View from park, looking east across buffer zone.



View of naturalistic drainage channel at eastern edge of park

Park Amenities

Park acreage	4.7
Playground	y
Picnic area	y
Baseball field	n
Soccer field	n
Water feature	n
Basketball court	y
Tennis courts	n

Park Perimeter Characteristics

Subcollectors	46.7%
Minor roads	0.0%
Private lots	17.8%
Alleys	0.0%
Other	35.5%

Frankford park is a new park in a conventional contemporary suburban fabric. A single collector road provides access to unconnected subdivisions, apartment complexes, parks, and shopping centers. Pedestrian access is difficult and indirect.


View from park looking west across eastern border at subdivision.

Frankford park has a small basketball court, playground and covered picnic structure, and is served by a parking lot for eight cars. To the south of the park is a commercial intersection, which wraps around the park to the east. Surrounding developments all have alleys, and back yards are completely enclosed.


View north along eastern edge of park.

Landscaping on the western side of the park is immature. The eastern side borders Winding Creek, a mature wetland with large trees and developed undergrowth. Southwest of the park is a large, as-yet-undeveloped meadow.

The park is a difficult study site. It is not part of a continuous urban fabric, it is near large commercial areas, and is adjacent to undeveloped parcels of land. It does, however, represent conventional park design practices in many suburbs. It also offers data on the impact of complex, indirect pedestrian paths on park value.

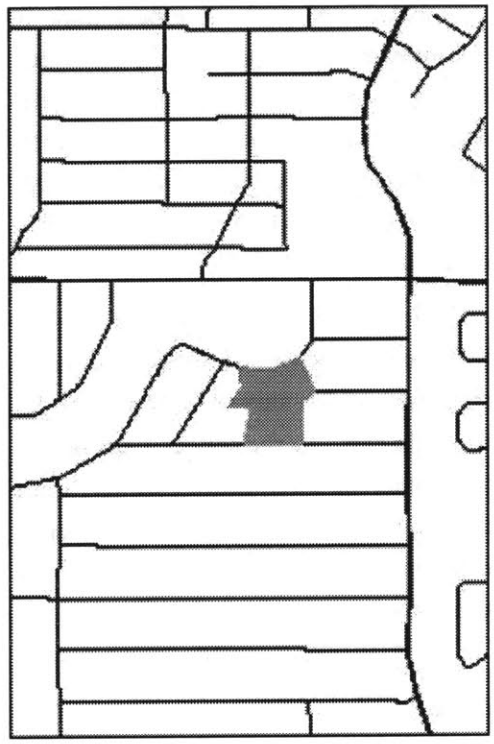

View looking west at playground.

Park Amenities

Park acreage	3.1
Playground	y
Picnic area	y
Baseball field	n
Soccer field	n
Water feature	n
Basketball court	y
Tennis courts	n

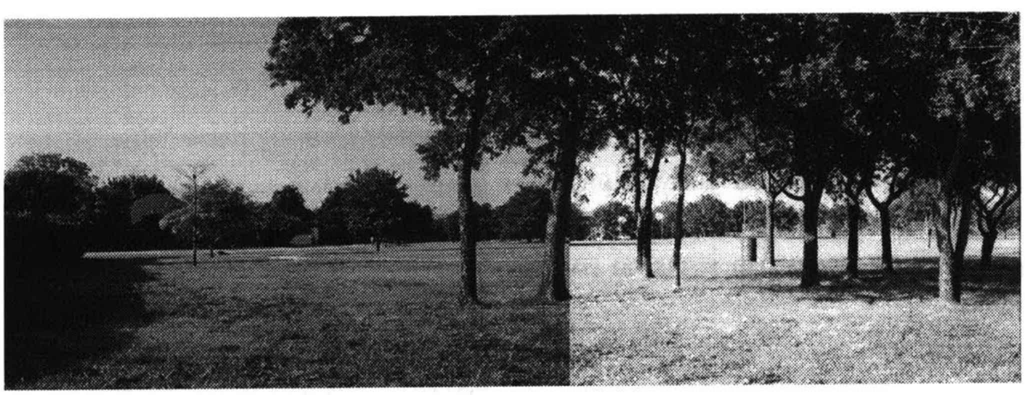
Park Perimeter Characteristics

Subcollectors	0.0%
Minor roads	45.5%
Private lots	34.5%
Alleys	20.0%
Other	0.0%



Old Renner Park

Dallas, Texas



View from northwest corner of park, looking southeast.

Old Renner Park is an attractive if under-maintained neighborhood park in north Dallas. There are two tennis courts at the southwest corner of the site, a basketball court next to it, and a small playground in the southeast corner. Picnic tables are scattered across the park, but there is no shelter. There are also no public facilities.

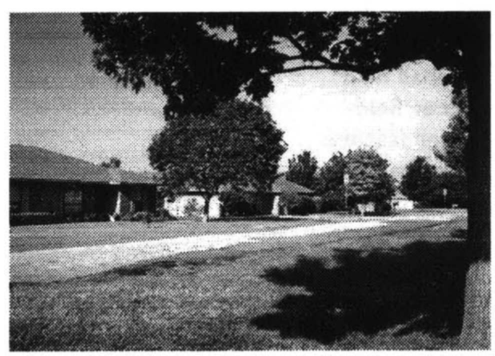
The northern side of the park is meadow with a cluster of young trees in the northwest corner. There are no planting beds, and the grass resembles mown pasture. There is considerable open space near the park, much of it roughly mown grass. The neighborhood feels underbuilt.

Abutting houses either block out views of the park with fences or, in the case of side abutting properties, ignore it entirely. Houses near the park are middle class one-story homes, while homes under construction nearby are more expensive.

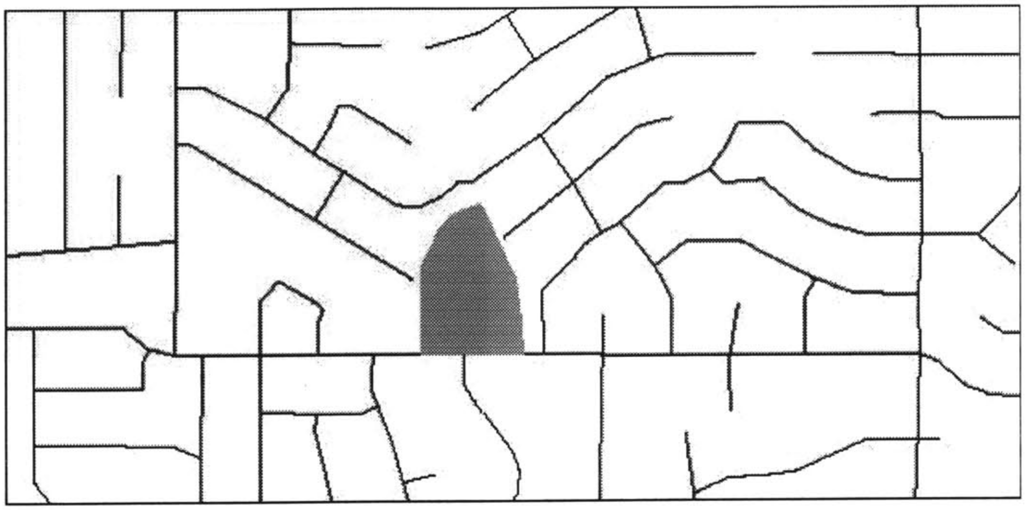
The park may reveal problems with providing parks at the urban periphery. Since open space is in ample supply, parks need to provide distinct amenities and experiential qualities to justify their costs.

View from northwest area of park, looking south at fenced yards.

View looking north at park sign, playground, and basketball court.



View looking north from alley connecting Riseden Drive with Sunhaven Lane.



Duck Pond Park

Coppell, Texas

View looking south toward pond.

Park Amenities

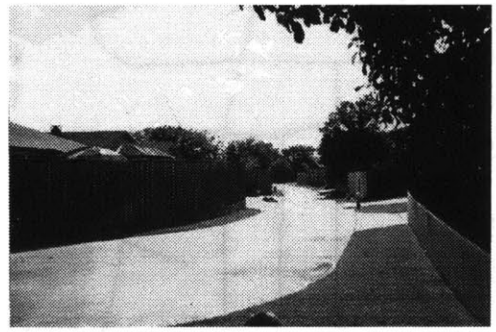
Park acreage	5.1
Playground	y
Picnic area	y
Baseball field	n
Soccer field	n
Water feature	y
Basketball court	n
Tennis courts	n

Park Perimeter Characteristics

Subcollectors.........26.1%
Minor roads.........11.1%
Private lots...........62.8%
Alleys.......................0.0%
Other.......................0.0%

View from southeast corner of park.

Duck Pond Park is a well-maintained park in the city of Coppell. Its large pond includes an aeration fountain, and tree-shaded drainage channels lead to and from the pond. A meadow wraps around the western side of the park, while the eastern side is forested with mature shade trees. There are several picnic tables, but no covered picnic areas.



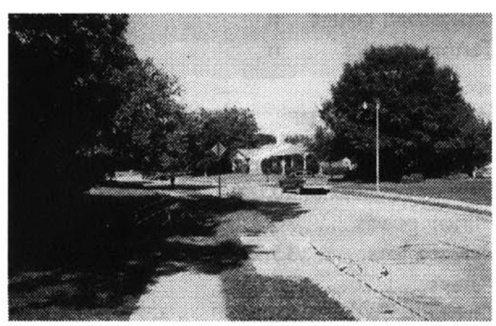
View of alley near park, showing fencing of private yards.

Single story homes comprise the surrounding neighborhoods. There appears to have been very little remodeling done since construction on most properties. A more exclusive neighborhood, with a more diverse range of house sizes and styles, lies to the south of the park.

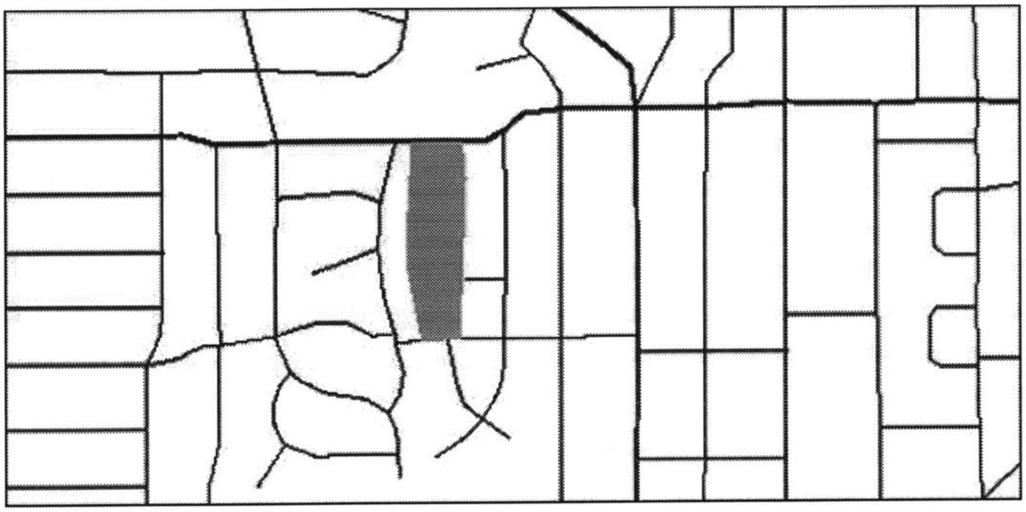
View of cul-de-sac along eastern edge.

Alleys serve homes in the surrounding neighborhood, and back yards are almost universally fenced. In most cases, the finished faces of the fence boards face inward.

The western park boundary is very porous. Park stretches to the front door of several houses. Here, the park is clearly an amenity. Unlike on the eastern side, where a fence clearly delineates the public from the private, the border here is not absolute. Rather, one becomes progressively less comfortable about the limits of the park as one gets closer to the homes.



View looking east from northern edge of park at adjacent homes.



Redbud Park
Hurst, Texas


View south toward playground

Park Amenities

Park acreage	7.3
Playground	y
Picnic area	y
Baseball field	y
Soccer field	y
Water feature	n
Basketball court	n
Tennis courts	n

Park Perimeter Characteristics

Subcollectors.........0.0%
Minor roads.........26.3%
Private lots...........35.2%
Alleys.......................0.0%
Other.....................38.5%


View toward soccer field

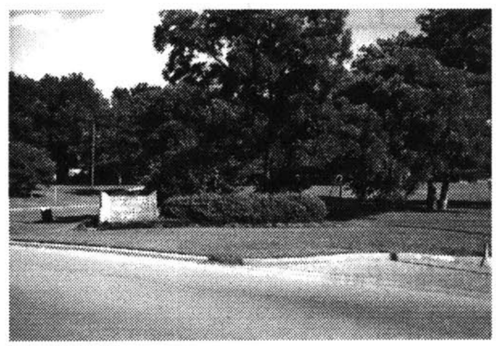
Redbud Park is a long north-south park bordered to the east by private lots and to the west by a fenced drainage basin.

The park includes paired ball fields set on opposite corners of a soccer field to the north. It has extensive playground equipment, picnic tables, and a substantial picnic structure to the southwest.

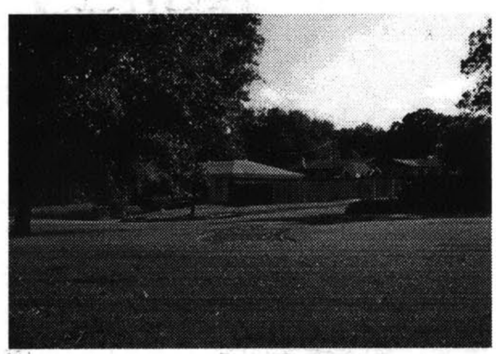
Landscaping is mature. Trees are clustered along the park's pedestrian path and in a central grove around the playground.

Houses on the northern edge face the park. They are one story ramblers, and do not appear to have been renovated extensively. Houses to the west have low chain link fences, which would be necessary to protect children from the drainage channel. The ground slopes up to the west, and the homes there are difficult to see behind the foliage. Houses to the east also typically have chain-link fences. At the corner behind one ball field, and adjacent to the southern parking lot, two homes have erected high wooden fences. However, the strip of trees along the eastern edge shields those houses from easy view from the park. Houses to the south front onto Bowles Court, which heads south from Cullum Avenue.

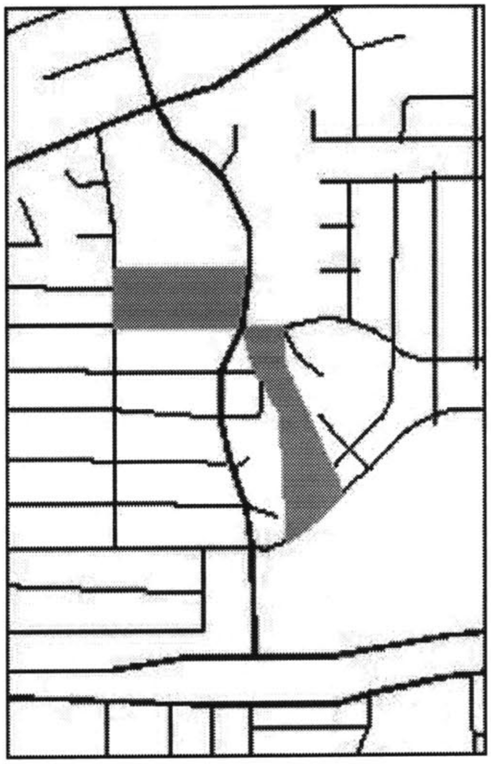
View of picnic structure at southern edge of park and adjacent homes. Note the lack of a defined edge.



View of northern edge of park and signage.



View looking southwest at adjacent homes.



Mayfair Park
Hurst, Texas

Park Amenities

Park acreage	7
Playground	n
Picnic area	n
Baseball field	n
Soccer field	n
Water feature	n
Basketball court	n
Tennis courts	n

Park Perimeter Characteristics

Subcollectors.......23.8%
Minor roads.........27.6%
Private lots...........48.7%
Alleys.......................0.0%
Other.......................0.0%

View looking east across drainage ditch.

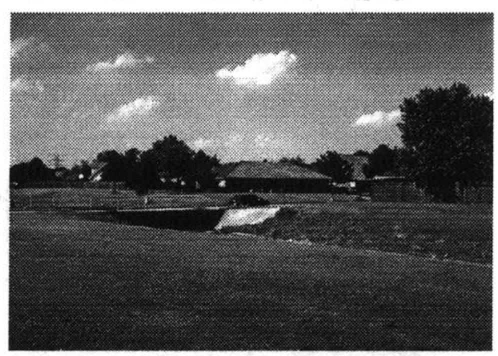
Mayfair Linear Park is a long, under-maintained park backed by houses on both sides. A large drainage ditch dominates the park, splitting the park in half along the north-south axis. There is no parking lot, but plenty of on-street parking. The park has no trees at all, no benches, no facilities of any kind. It is, the park conceived as 'open space'.

View of drainage ditch and nearby homes.

Most of the houses that back onto the park have wooden fences, though a few use chain-link instead. Houses are low, typically one-story, with contiguous garages.

View looking south at abutting homes.

According to one long-time abutting neighbor of the park, the city of Hurst ran out of money and so left the park unfinished. The park was used by the local residents, she said, but wasn't really nice enough to attract people from outside the neighborhood. A baseball field, for example, would attract to many visitors. She believed her property values were higher than those of houses not on the park, and that the prices were more stable over time. Strangers regularly offered unsolicited bids on her house. She attributed this price effect to the park's proximity, which provided openness and privacy to the house.



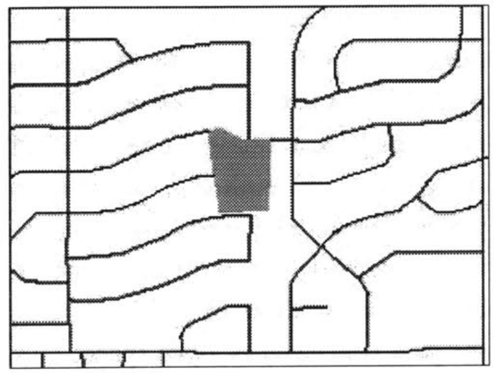
View looking northeast along ditch.

Park Amenities

Park acreage	4.5
Playground	y
Picnic area	y
Baseball field	n
Soccer field	n
Water feature	n
Basketball court	y
Tennis courts	y

Park Perimeter Characteristics

Subcollectors	0.0%
Minor roads	49.8%
Private lots	8.6%
Alleys	41.6%
Other	0.0%

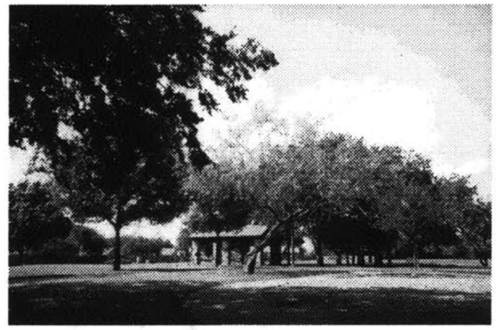


Holman Rhoton Park

Carrollton, Texas

View from corner of park, looking southeast toward playground.

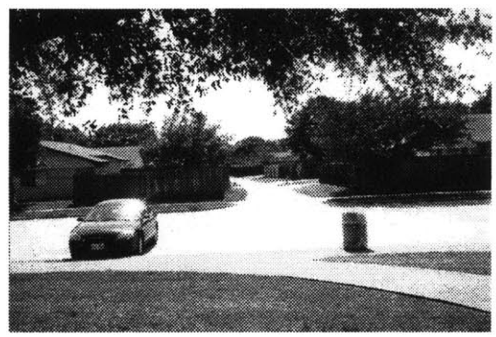
View looking southwest from picnic area.



View looking across playground at picnic structure and parking lot beyond.

Holman Rhoton Park is a small, well-maintained park in Carrollton, Texas. The park has several edge conditions, including private lots, streets, cul-de-sacs, and alleys. Homes abutting the alley that borders the park do not access the alley. There are no garages, and most homes ring their yards with low chain link fences.

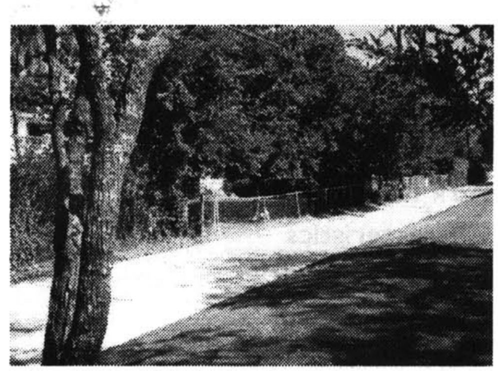
This is a passive leisure park. The park includes picnic tables, barbecue pits, and a substantial covered picnic structure. A large children's playground sits in a clearing in the center of the site. . There are two tennis courts in the northeast corner of the park, and a basketball court adjacent to this. A Parking lot for approximately ten cars is accessible off an abutting street.



View from park to adjacent houses.

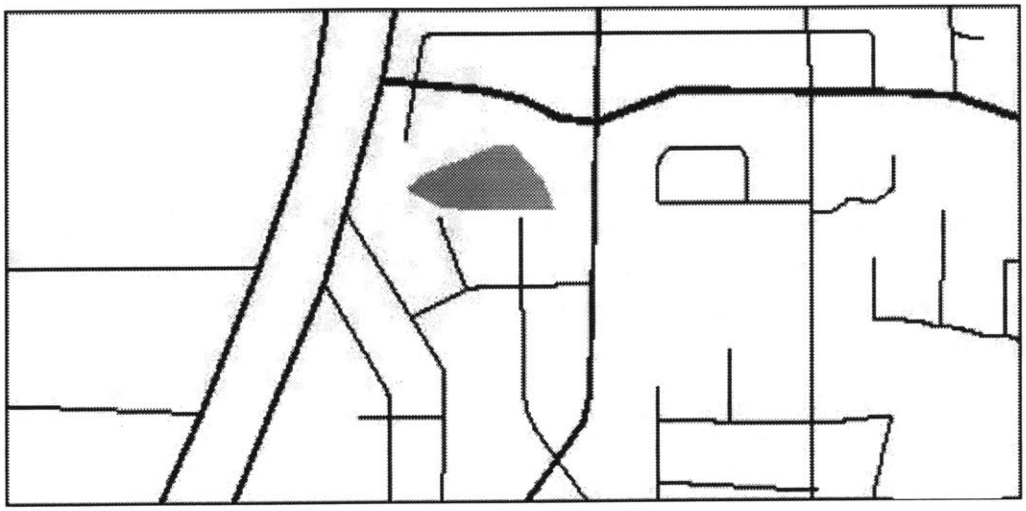
The park's landscaping is fully mature. There are several nice specimen trees in the northwest corner of the park. In the southeast, a dense grove of young trees casts deep shadow.

Houses in the neighborhood are uniformly single story, ranch style houses. Little gentrification is visible around the park.



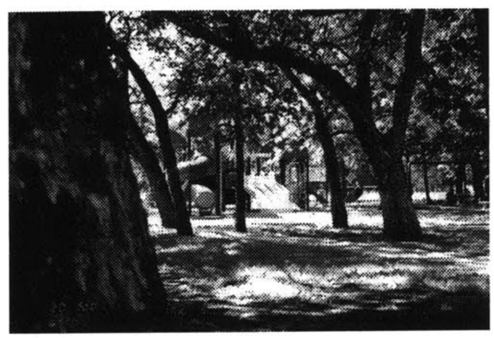
View of alley along eastern edge of park.

The park is a very nice neighborhood park whose edge conditions and placement in the urban plan may diminish its value to the surrounding neighborhood.



Jaycee Baker Park

Hurst, Texas



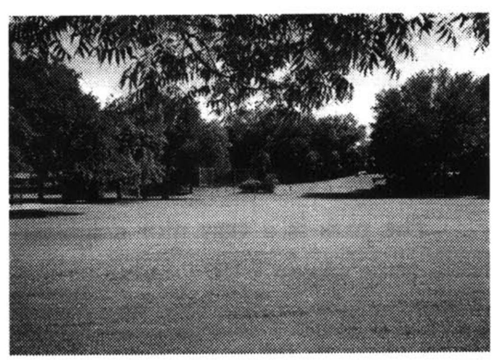
View of playground in grove of trees.

Park Amenities

Park acreage	4.1
Playground	y
Picnic area	y
Baseball field	y
Soccer field	n
Water feature	n
Basketball court	n
Tennis courts	n

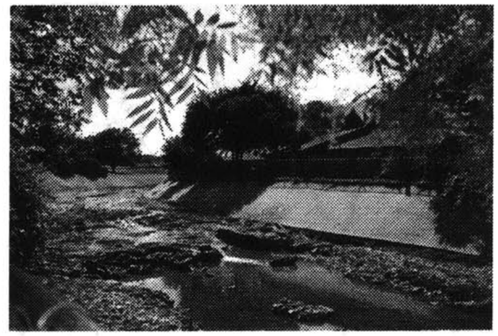
Park Perimeter Characteristics

Subcollectors	0.0%
Minor roads	10.0%
Private lots	55.3%
Alleys	0.0%
Other	34.7%



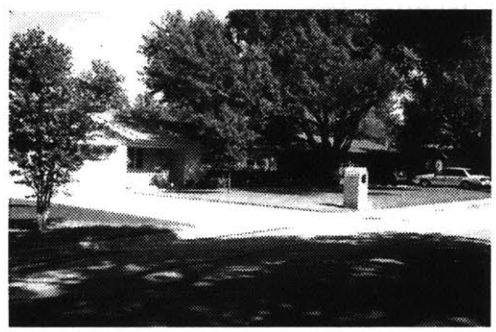
View from northern edge of park, looking back at ball field.

Jaycee Baker Park is an attractive, well-maintained park in Hurst, Texas. The park has a nice, shaded playground, picnic tables, locked public facilities, and a ball field. Landscaping is fully developed and well-maintained.



View of drainage channel at northern edge of park.

The park is bordered to the north by the Billy Creek drainage channel, a formidable storm channel with concrete walls and chain link fences running along the top at both sides. Houses abut the park to the south. The only path to the park ends in a small parking lot for about eight cars. A major arterial divides the neighborhood to the west of the park.



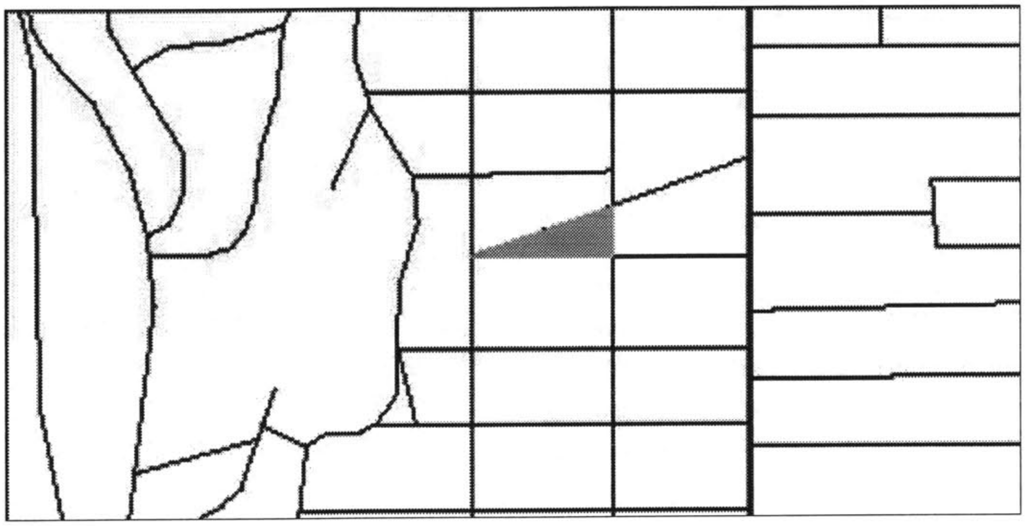
View of typical houses in neighborhood

Houses south of the park used low chain-link fences instead of high wooden ones, increasing the park's apparent size. These houses also benefit from the grade change, which gives them a commanding presence.

Houses in the area are almost uniformly one-story ramblers. Garages are attached and open directly off the street, but a few houses have side entry or garages in back. The houses are very low, and lots are very wide.

View of street leading to park.

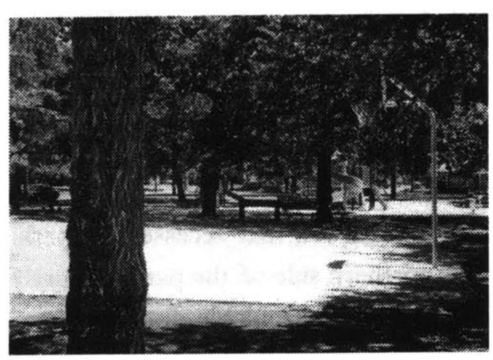
The park marks an extreme of inaccessibility. There is one road, ending in a parking lot, that accesses the park. The northern side of the park is entirely blocked by a formidable drainage channel.



Oakhurst Park

Fort Worth, Texas

View looking south at Oakhurst Park.



View of playground in park

Park Amenities

Park acreage	0.5
Playground	y
Picnic area	y
Baseball field	n
Soccer field	n
Water feature	n
Basketball court	n
Tennis courts	n

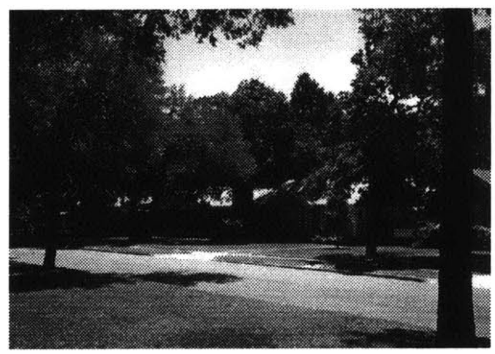
Park Perimeter Characteristics

Subcollectors	0.0%
Minor roads	100.0%
Private lots	0.0%
Alleys	0.0%
Other	0.0%

Oakhurst Park, in Fort Worth, is a small triangular park ringed by roads. The park has several picnic tables, a barbecue stand, and a new playground built in 1993. Landscaping throughout the neighborhood is mature, with many beautiful oak trees.

View of neighborhood entrance.

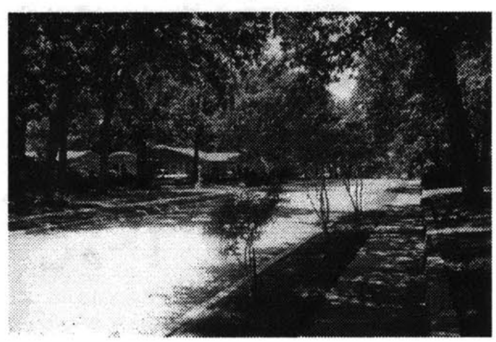
Houses around are almost exclusively single-story, with a mix of ranch-style homes and arts and crafts bungalow. Garages are either attached or set behind the house and accessed off the main street by a narrow driveway. There are no alleys nearby. The neighborhood has few fences, and the few that exist are low.



View of houses on southern edge of park.

Little gentrification is visible. The neighborhood has a distinctive identity, bolstered by street signs and ornamental piers at the entry points to the neighborhood. Residents noticed me as an outsider, and stopped to question me about my activities.

To the east of the neighborhood is a dilapidated commercial strip with a few abandoned gas stations from the forties and sub-prime commercial uses.



View showing character of nearby street.

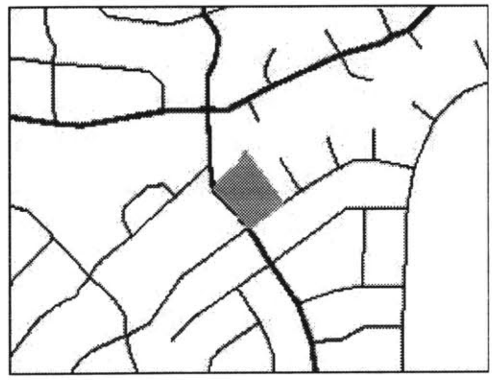
The neighborhood has a simple gridiron plan with established houses. It suggests the potential of the minimally designed but carefully detailed street grid to produce viable neighborhoods.

Park Amenities

Park acreage	2.5
Playground	y
Picnic area	n
Baseball field	n
Soccer field	n
Water feature	n
Basketball court	n
Tennis courts	n

Park Perimeter Characteristics

Subcollectors........28.6%
Minor roads..........22.0%
Private lots...........26.0%
Alleys......................23.4%
Other.......................0.0%



Pagewood Park
Dallas, Texas

View of play structure in park

View looking north at park and alley on eastern edge.

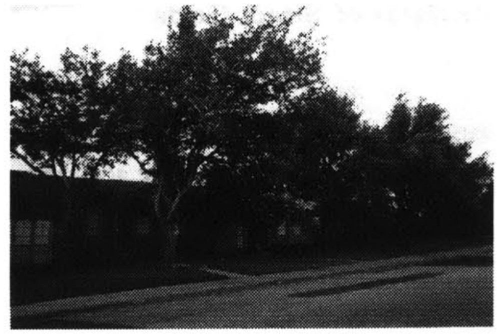
Pagewood Park is a passive leisure park north of University Park. Streets border it to the south and west, alleys to the east, and lots to the north.

Landscaping is limited. There was once a planting bed at the eastern corner of the park, now removed. A few immature trees cluster along the arterial. There is a small play structure near one corner of the park. Landscaping at the northern end of the park is more extensive, but the boundary between public and private is difficult to ascertain. The park slopes down to the north, making ball fields problematic. A creek runs along the edge of the park.

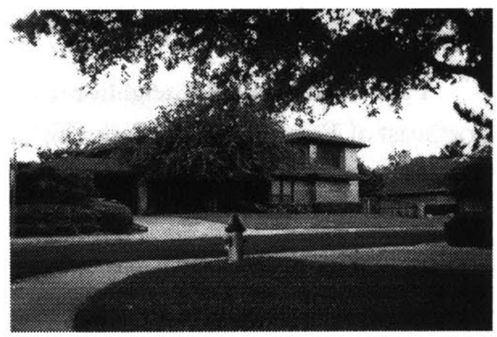
The park has no dedicated parking, but plenty of on-street parking. It has no paths, facilities, picnic tables, or barbecue boxes.

The neighborhood to the south and west is dominated by duplexes, many of them rentals. Many houses present blank facades to the street and use alleys for access and parking. Roofs are often massive and monolithic. Townhouses line the southern edge of the park. Single-family homes to the east and north are accessed off cul-de-sacs.

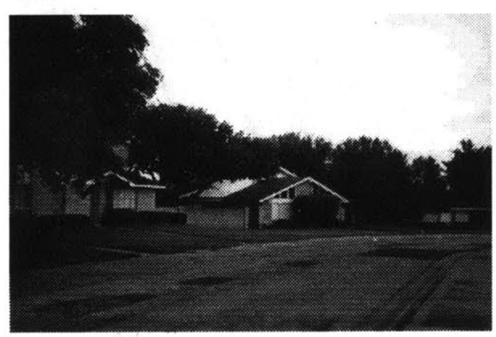
The neighborhood includes several housing types and price ranges in close proximity. Density levels appear higher than around most other study parks.



View of nearby apartments.



View of nearby house.



View of nearby duplex.

Analysis of Street Grids

The range of street grids in the sample set produces a variety of transportation cost contours. The accompanying illustrations show similar contours for each of four parks.

Preston Hollow Park, one of two study parks in an approximately gridiron neighborhood, has a contour resembling the models. The difference between the western and eastern side of the contour indicates the importance of cross streets in providing pedestrian access.

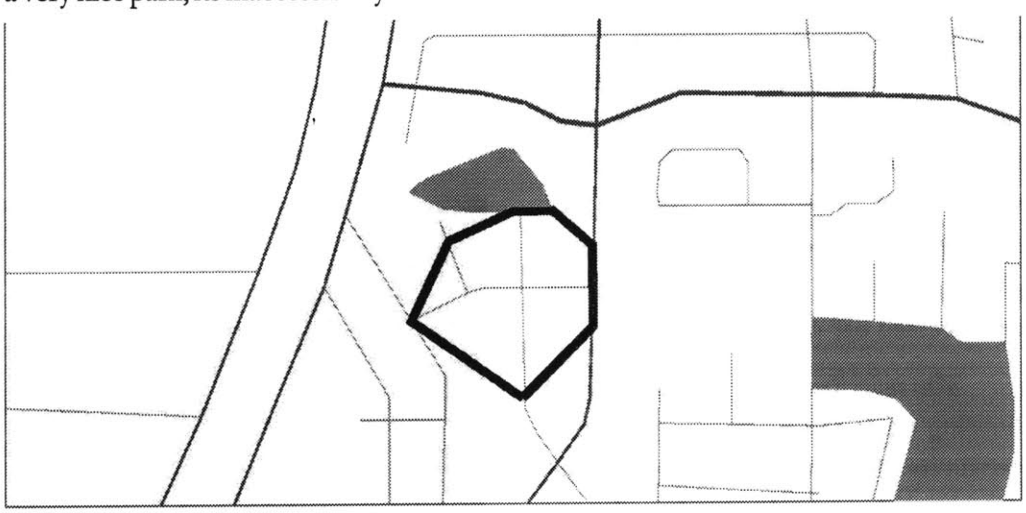
Pagewood Park, in a neighborhood northeast of Preston Hollow Park, shows the distortion in the contours caused by diagonal access roads.

Jaycee Baker park represents an extreme of inaccessibility. Despite being a very nice park, its inaccessibility restricts sharply its value to the surrounding neighborhood.

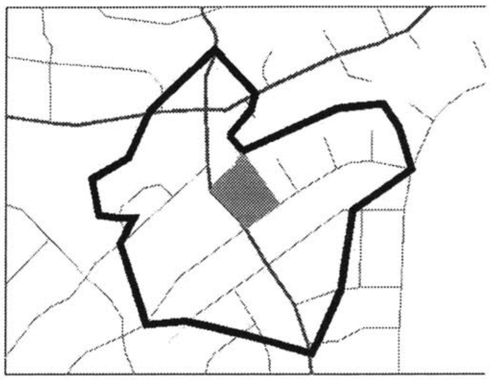
Frankford Park, abutting a major arterial, has at best the theoretical accessibility shown in the diagram. In practice, the park is inaccessible to nearby properties regardless of distance.

As progressively longer walking distances are chosen, the shape of the contours will become more regular. If the street plan is an open network, the significance of minor variations in that plan to distant houses will be low.

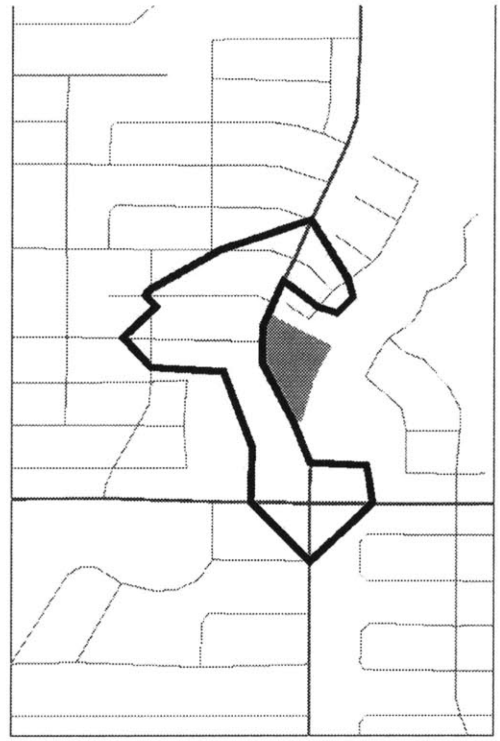
Premiums decline sharply within the park's immediate vicinity. Indeed, about 1/2 the net premium associated with the park occurs within 350 feet of the park. Small differences in the street plan near the park may have a strong impact on the park's viability.



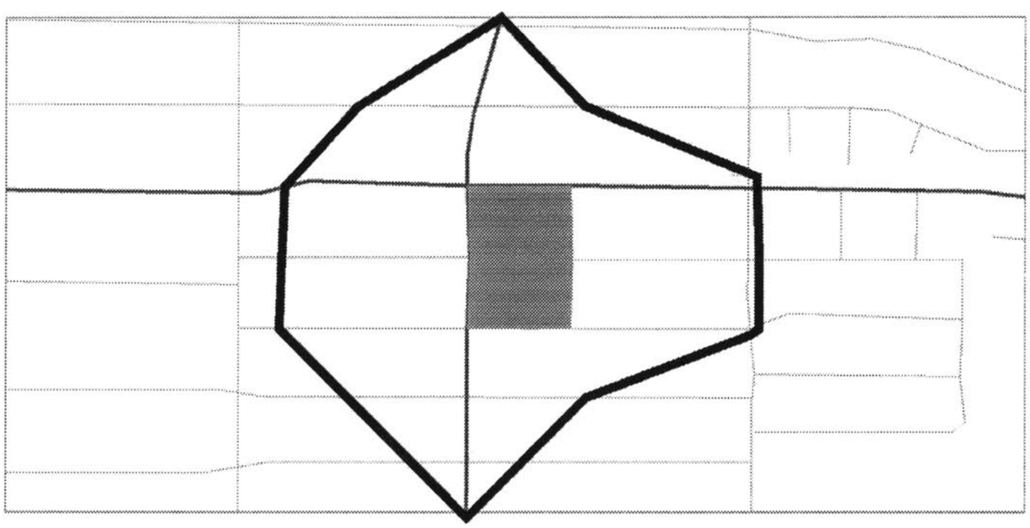
Jaycee Baker Park



Jaycee Baker Park



Frankford Park



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